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THE
GEOGRAPHICAL REVIEW

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PRINCIPLES IN THE DETERMINATION OF BOUNDARIES*

By ALBERT PERRY BRIGHAM
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Three Stages of Civilization

THE TRIBAL STAGE

The student of boundaries must take account of a threefold evolution, marking a primitive, or tribal, stage, in which such lines do not exist; a mixed, or transitional, stage, in which demarcations are shifting but gradually embrace all regions of the world; and a third, or ideal, stage, in which they become in great part fixed and at the same time of diminished importance save for convenience of administration. We are now in the second stage, and some would deny that the third condition can ever become effective.

In the hunter-nomadic type of world economy there is room enough; tribes grow up in their own centers, with more or less clash in their wanderings; but frontier problems do not press, and the limits of ownership are vague. Such boundaries as existed in early times were without plan or consciousness on the part of the groups that were separated. The world was comparatively empty. Groups expanded in regions where hunting, fishing, pasture, and simple tillage were favored. Over the mountain ridge, beyond a belt of desert, or across a lake or salt sea were other assemblages of men. There were no maps, no surveys, and no boundary lines; there were only separating zones. As put by Professor Lyde, the frontier was the farthest region from which the tribe could get food.[1] It was the domain of self-sufficiency for an embryo nation.

Another English writer sees a vivid picture of the hunter expanding his radius, meeting others expanding their radii and becoming man hunters, the ancestors of the warrior nobles of the Middle Ages and of the Renais-

* Read at the fourteenth annual meeting of the Association of American Geographers, Baltimore, December 27-28, 1918.

[1] L. W. Lyde: Types of Political Frontiers in Europe, *Geogr. Journ.*, Vol. 45, 1915, pp. 126-145.

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sance, down to the imperialists of the present day.[2] In the war from which we have now passed is evidence that primitive conditions have kept a stubborn grip on a changing world.

The Transitional Stage

The second stage shows developed civilizations and high densities of population in large parts of the world, with primitive or semi-civilized peoples elsewhere. Frontiers of the modern and definite kind abound in more advanced regions, which shade off into penumbras of spheres of interest, spheres of influence, protectorates, and buffer states. In so far as less-developed lands are held as colonial property, as in Africa, demarcations are as essential as in Europe.

Boundaries as we know them, as the schoolboy learns them, strict lines of separation, are therefore features of maturing civilization, with growing densities and increasing pressure on natural resources. They have in the past been commonly put as far out from the center of the group or nation concerned as its numbers and needs required, or as far as the ambitions and the power of its rulers made possible. During many centuries boundaries have been laid down in treaties, and treaties have been, in the main, the expression of power, power to get and power to prevent an enemy from getting.

The Ideal Stage

The final stage, to which we look, offers a world full of autonomous nations, all fitted for self-government and fitted to live in amity with their neighbors to mutual profit. Self-restraint as a mark of national policy is a development of our own times. Nations are learning the futility of Alsace-Lorraine experiments in boundary shifting. Many boundary disputes which in earlier times would have been settled by conflict have in the last hundred years been peacefully adjudicated.

We are approaching, or we should like to think we are approaching, the time when national limits are to be set for equal welfare on both sides of the line, when considerations of defense and of aggression fall out of sight, and justice is the only goal—justice involving the administrative convenience, reasonable self-sufficiency, and economic co-operation of national groups. So far as this ideal is reached, a line across a plain may be as good as a mountain range, the forty-ninth parallel as useful as the Pyrenees. Under such ideal conditions international lines would be little more than our bounds of states, counties, and towns—they tell us where to vote, where to pay our taxes and record our mortgages, and who will build roads for us, police us, and otherwise carry out our will in the various spheres of government. As state and civic pride still abounds, we need not fear that patriotism will die.

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[2] Patrick Geddes: Boundaries and Frontiers, *Westminster Rev.*, Vol. 169, 1908, pp. 257-260; reference on p. 257.

Thus we meet the question of today: How far have we passed out of the tooth-and-claw stage of human relations? Have we even touched a dim, outer zone of the millennium? If victory had rested with the enemy we well know on what principles boundaries would have been drawn. Victory being where it is, just and rational boundaries, we may safely hope, will safeguard peace in our time. Here, then, is our point of departure for a summary of the principles which control the fixing of boundary lines.

Two Opposing Theories of Boundaries

Two opposing types of view have been set forth by British geographers during the past four years. These authorities are Colonel Sir Thomas Holdich and Professor L. W. Lyde, and their conclusions are developed in several published volumes and in a series of essays appearing in the *Geographical Journal*, the *Scottish Geographical Magazine*, and the *Nineteenth Century*.

Holdich's View: The Defensive Function of Boundaries

Sir Thomas Holdich is recognized as pre-eminent among those who have had actual and long experience in boundary demarcation. He is a soldier and represents distinctly the military and defensive conception of the function of boundaries. It is his deep and unalterable conviction that signs of international good will are not frequent enough to warrant boundary fixing "which would lead to the mingling together of the human fringes of the nations."[3] But if the fringes are already entangled we are at liberty to ask what we can do about it. It is indeed fair to remind ourselves at this point that Holdich is contesting Lyde's view that boundaries should of set purpose be put where population is dense and where people are forced to meet one another. Man being "a fighting animal, he must be prevented from physical interference with his neighbor by physical means. . . . A boundary must be a barrier." Ergo, if there be no barrier, we must rely on armament and fighting—a rather hopeless outlook. Yet Holdich admits the need of considering *first* the sentimental values in a boundary dispute; but he returns—and who, after England's four years, will wonder?—to the conclusion that "security means armament," an artificial protection if no natural defense is possible. No rosy hopes of millenniums should blot out the lesson of tears and blood. Of all barriers, mountains are "incomparably the best." Holdich often recurs to the Himalayas and the Andes, but most of the world, and most of the people of the world, are not on the two sides of the Andes or the Himalayas; and the Alps, the Carpathians, and the Pyrenees fall far short of supplying high fences for Europe's dense and diverse millions. Failing high mountains, Holdich comes to common divides and water partings. These indeed are determinable and, for human periods, reasonably stable; but are they defensive?

[3] T. H. Holdich: Political Boundaries, *Scottish Geogr. Mag.*, Vol. 32, 1916, pp. 497-507.

Recognizing that small elevations are more common than Pyrenees, our author reverts to the defensive value of hills, supplemented by forts and trenches, and thus practically surrenders his major contention for natural ring fences and falls back upon the primitive method of keeping the world in some kind of order. These admissions are hardly consistent with the opinion that "there are but few wide spaces existing in the world where some adaptable features of natural topography are not to be found ready to his (the boundary maker's) hand." On the other hand, one may freely ask where, in the thousands of miles of Eurasian plain that stretch from the Pyrenees to Vladivostok, can a boundary expert trace around any nation "a sound, defensible line" within which it "may find peace and security." We may well fear that a doctrine of natural encirclements will delude us with empty hope; and, in default of international good will, send us along the rough road of recurrent war and patched-up peace.

Lyde's Theory of Assimilative Boundaries

Professor Lyde approaches the subject from the point of view of the human geographer and brings to bear upon it his wide knowledge of the historical, racial, linguistic, and economic relations of human groups. Nowhere are his views more compactly expounded than in his essay on "River Frontiers in Europe."[4] He refers to Holdich's then recent paper before the British Association as setting forth a purely military doctrine of frontiers, as if war were the normal state of man. If a mountain barrier is far better than all others, then a boundary is good, not as it promotes, but as it prevents intercourse. A boundary must on the other hand be an international feature; it must be obvious, indisputable, a promoter of relations in peace and a barrier in war. Lyde cites the Plate, long a frontier line but never a source of friction as regards the countries bordering it. Civilization is "progress in the art of living together," and the world long ago became an economic unit. It is the navigable river which encourages "a maximum of peaceful tendencies." As to the defensive value of rivers, the case of the Danube is cited as having defended Belgrade for four months, in 1914, in the second Austrian attack. It is of course easy to remind ourselves of what happened to Belgrade at a later stage of the war. Many rivers of Russia are cited as having protected the great retreat, especially those rivers which had no marshy bordering plains but did have parallel railways behind them, a combination which "gives a defensive position of enormous strength." Such a barrier may be as good as a mountain range, especially as mountains often have an arc form or a steeper front on one side than on the other, thus destroying the defensive equilibrium as between the two sides. Mountains having failed to keep enemies apart in the sad past, why put large faith in them now?

Rivers favor cultural and linguistic assimilation and the incoming of

[4] *Scottish Geogr. Mag.*, Vol. 32, 1916, pp. 545-555.

outside ideas and of international tendencies. "We *want* the two nations to be unified in all except political allegiance." The frontier embodies a formal contract which commercial communities, common on rivers, are more likely to respect than are nomad highlanders. Lyde's closing sentence in this paper has the tone of prophetic warning. "If the new map of Europe is based on purely military lines, Europe will have to expiate it—once more—on purely military lines."

Such are the alternatives offered. On the one hand nations may not trust each other and must have defensible borders. Such defenses are hard to find and, when found, must be supplemented by artificial constructions and armies. All being done, the best defensive arrangements are likely to be neutralized by destructive modern invention. On the other hand is the hope, more or less theoretical and academic, promulgated by a university professor, that nations will live together in reasonable amity, assimilating themselves to each other, preferably across the narrow waters of a river.

Physical Geography and "Scientific Boundaries"

Those who follow Holdich make much use of the phrase "scientific boundaries." We may inquire whether there are such boundaries, seeking thus to know what the words really mean. We suppose natural features are intended, which man seizes for his purpose; and this purpose is assumed to be division and to involve separation and defensibility, as viewed from both sides. There are four commonly recognized kinds: mountains and water partings in general; deserts; seas; and rivers. Of all these we may say that they show infinite diversity, irregularity, and confusion in magnitude and in form and that they offer a limited assortment of sharply defined, unmistakable, and unchanging divisions.

Mountains

Mountain ranges do not commonly offer single, commanding ridges, but break into components running in rough parallelism, or at various angles, with intricate and sometimes elaborately trellised systems of drainage, developing on maturing mountain fields of the Appalachian type. The Jura, lying between France and Switzerland, is a pertinent example. Water partings are far from meeting elementary notions of rooflike separation and show vague cols joining the opposite slopes of a plateau, or the uncertain and shifting sources of streams in vast glacial marshes.

Deserts

Perhaps the best historic example of desert boundaries is found in Egypt. Here for thousands of years was a densely peopled area, shut off on three sides by an arid wilderness and on a fourth by a sea which knew no developed art of navigation. Yet Egypt managed to fight and to be fought,

in spite of her natural seclusion. Now we carry millions of soldiers in ships, run a railway across the Sinaitic desert, and mark the aërial passage of a schoolmaster from the Holy Land to the Nile in fewer hours than it took decades for the Hebrews to go in the opposite direction. The near future holds railways across the Sahara and over the arid wastes of Australia, while express trains have long crossed the Great American Desert from the Rio Grande to the Saskatchewan.

Seas

Seas have been regarded as efficient boundaries of the "scientific" order. The American red man was long safe from pale-faced conquerors through the fending power of the Atlantic; but Roman and Carthaginian were getting marine practice in effective military crossings of the Mediterranean, and the Strait of Gibraltar did not save the Iberian Peninsula from centuries of African rule. America now yields her claim to isolation as never before in her history and is beginning to recognize that the jingo myths of some American school histories, rather than the Atlantic Ocean, separated the United States from the mother country.

Rivers

Under the influence of the old, defensive ideals, geographers have not thought that rivers were good boundaries. People on the opposite slopes and flood plains of a river valley tend to meet and to engage in like activities. A river is indeed a military obstacle, and armies have sacrificed thousands of men in the present war in seizing bridgeheads necessary to their advance. George has pointed out that a river is always a weak spot in the communications of an invading army.[5] One does not quite understand Lyde's contention that a river backed by a railroad is a strong defense, in view of the range and power of the artillery which may be assembled on the opposite bank. Other objections to rivers as international borders offer themselves. Some rivers disappear seasonally, or they shift their courses, or their waters are withdrawn for irrigation. Public works of large variety belong to river courses, and the people of both banks must be equally interested in their control. Water rights must be established in relation to domestic supply, pollution, industrial power, and navigation. Bridges, cables, and ferries are to be added to the catalogue of a river's belongings. All these things involve and imply intimate and friendly relations.

But, however we urge the limitations of rivers, we cannot rule them out if assimilative boundaries are to have significance in the future. Indeed, if we go back to the defensive idea, we must still use rivers in Europe, because they have some value and are far more numerous and available as dividers than any other class of natural features.

[5] H. B. George: The Relations of Geography and History, Oxford, 1901, p. 30.

Niagara Falls, a name marking two communities, one in Canada and the other in the United States, is an example of several of the problems named above, and it may be urged that they have been amicably solved. But the forty-ninth parallel has been as good a divide as Niagara River or the Great Lakes, and the same reason may be affirmed in relation to both—a decently disposed people lived on each side of the line.

Lakes are related to rivers as they are to seas, when viewed as boundaries. Marshes offer a belt, like the desert. They are like the desert in being hard to cross; but they present a different sort of difficulty in crossing and in some future time may be reclaimed, deforested, and provided with roads.

World Survey of Physical Boundaries

The Americas

Light is thrown on our problem by the most cursory inspection of the world map. The northern boundary of the United States begins in the east with the ragged outline of Maine, which projects far north into the basin of the St. Lawrence River and historically represents geographic ignorance, was settled by a series of painful negotiations, and violates all notions of a scientific boundary. The line through the upper St. Lawrence and the Great Lakes is a natural line until the north shore of Lake Superior is reached, where it leads off through a tangle of lakes and marshes to the Lake of the Woods. Thence the forty-ninth parallel is used, and we have the authority of Holdich for the badness of straight lines, as being expensive to determine and mark and as paying no heed to topography or human choice.

The last objection has little value here, since the line was originally run through an uninhabited region. The first objection has this support, that the line as marked diverges in places as much as 2,000 feet from the astronomical position.

The southern Alaskan frontier is cast through a tangle of high mountains and is widely held to be unjust to Canada, in that it shuts off an enormous Canadian hinterland from direct access to the sea. Sufficient reference has already been made to the Rio Grande, and the remainder of the Mexican boundary is wholly arbitrary. North America is assuredly poor in boundaries of military or separative value.

The same is to be said on the whole of South America. Brazil is bordered by ten political units, of which seven are autonomous nations and three are colonial possessions governed from Europe. On the side of the three colonies the line follows the water parting. Sections of rivers form part of the lines toward Paraguay and Uruguay. We think of Brazil as the country of the Amazon, yet vast areas of Colombia, Ecuador, Peru, and Bolivia reach over into the mazes of the Amazon forest.

The southern stretch of the Andes nearly led Chile and Argentina into

a boundary war, which was averted by reference to a British commission, of which Sir Thomas Holdich was a member. The line was by treaty to follow the heights of the range. Investigation in an unmapped region showed that the water partings were well eastward of the line of main crests. Hence the problem; the solution kept the peace but is in no way scientific. If we follow the view that rivers are not desirable as boundaries, then the middle Andes, shutting off northern Argentina from northern Chile, are the only good international boundary in South America.

Africa and Asia

Africa tells the same story, if possible in stronger fashion. Because the continent has little in the way of sustained mountain ranges and is bordered by a smooth shore line, the available features are rivers, lakes, and deserts. The greatest African rivers function to a small degree in this field; the Niger not at all, the Nile but slightly, the main stream of the Congo only in a part of its lower course. The Zambezi, Limpopo, Vaal, and Orange Rivers serve only as between British dependencies, assuming that German Southwest Africa will pass to permanent British control. The great African lakes play a part comparable, in the future it may be, to the international functions of our own Great Lakes. Egypt has already been considered. No African country can rest its security upon physical boundaries.

Before we come to Europe, there remains Asia. Asia, in the large, is a central highland with a lowland fringe. Central Asia is a barrier in itself, mountain and lofty plateau, deserts of rock and snow, deserts of aridity. Northern India, on the southern edge of this great core, has, in the separatist view, the finest boundary in the world, yet nowhere has British nervousness been more fully exhibited, and nowhere have we such an outfit of spheres of influence, protectorates, and buffer states as here.

The Amur, the Mekong, and the upper Oxus are the main examples of river boundaries. Recent history is sufficient commentary on the physical security of Manchuria, with Russian influence reaching across a great river and Japan seeking protection and grasping for power across the sea. The plains of Mesopotamia are shut off from the world by deserts and mountains, and they have been the football of military powers from the dawn of history to the twentieth century. Writers upon Palestine divide their emphasis between the isolation of the little land and its historic place on the highroads that for thousands of years have joined three continents. It is a long way from the armies of Assyria and Egypt to the crusades and the British victories of the past year.

Historical Survey of Physical Boundaries in Europe

So far the map does not speak loudly for the protective value of scientific boundaries. We pass to observe the type examples of Europe. Here,

if anywhere, we shall find demonstrative evidence that physical features are in high degree divisive and defensive.

The Pyrenees

"In Europe the Pyrenees form perhaps the most typical example of an effective mountain barrier . . . . they stand as they have stood for ages as the parting line between two Latin nations which so far have shown no tendency towards mutual assimilation or desire for cultural unity." This is the judgment of Holdich;[6] but the facts are not historically so simple as here asserted. Not taking account of earlier Phenician, Greek, and Carthaginian interests, the Iberian Peninsula, save for a brief Frankish invasion, was all under Roman sway down to the first barbarian incursion about 400 A.D. Since that time the peninsula, with a clean boundary on the crest of the Pyrenees, has been under one sovereignty only for a period of about half a century. During the invasions there was a Visigothic kingdom which extended far over the Pyrenees and generally reached to the Rhone valley. About 600 A.D. the range formed a clear boundary between the Frankish and the Visigothic kingdoms, but half a century later the Visigothic sovereignty again approximated the Rhone delta.

The Saracen attempt to bestride the Pyrenees was less successful, but even the blow dealt by Charles Martel at Tours did not end the Moslem ambition to get a foothold north of the mountains. Charlemagne held the Spanish March, and, as he came to his end, his strong hand reached across the Pyrenees as far as Barcelona and a stretch of the upper Ebro. At the time of the First Crusade, 1100 A.D., Navarre and Aragon were small states along the range, and the Kingdom of France included the Mediterranean shore line as far as Barcelona. In the fourteenth century the Pyrenees became the essential boundary, but there were minor fluctuations until the middle of the seventeenth century. It is to the purpose to observe that Napoleon put a large army into Spain and was baffled of his aim not by the "scientific" wall of the Pyrenees but by the fires of European resentment which determined to crush him and free the world from the menace of universal dominion. The human spirit rose, as it has risen today, and dwarfed all physical conditions.

The Alps

Granting that the Pyrenees are one of the best of protective boundaries, the Alps confessedly offer poor support to this type of view. This is widely recognized. "The Alps have not isolated like the Pyrenees."[7] "It was the fashion in Roman times to speak of the Alps as the rampart of Italy. They have at all times proved a singularly ineffectual one . . . Goths and Huns, Lombards and Franks, Holy Roman Emperors, French Kings, Na-

[6] T. H. Holdich: Political Frontiers and Boundary Making, London, 1916, p. 150.
[7] L. W. Lyde, article cited in footnote 1, p. 130.

poleonic and Austrian armies have swarmed over their ridges. The Alpine passes have served as the neck of an hourglass; the human sand runs through them easily either way."[8] To the same purpose Dominian quotes the lines of Cowper—

> Mountains interposed
> Make enemies of nations who had else
> Like kindred drops been mingled into one

and observes that "the passes of the Alps refute the poet's statement. Their uniting functions eventually overcame their estranging power."[9] Popular notions emphasize the unity and physical aloofness of Italy, shut into her peninsula and fended from icy winds by her towering Alps. Yet Italy has fought a bloody war to free herself from the threat of Trentino and the menace of natural naval fortresses on the farther side of the Adriatic Sea. The history of two thousand years does not here lend much support to the barrier theory.

The Alps were crossed by the armies of Hannibal, and the conquests of Caesar and his successors wiped them out as a barrier. Odoacer, a German barbarian, established in 476 a kingdom astride the Alps reaching from Sicily nearly to the Danube. The Ostrogoths overthrew Odoacer and still more completely ignored the mountains, pushing their frontier to the south bank of the Danube. The Lombards, also German in race, next occupied the Alps and pushed their sway almost to the end of the peninsula. Charlemagne's empire reached from the North Sea beyond Rome. The First Crusade saw the empire equally extended in the south. By 1360, when the empire was much broken, it still reached over a part of the Alpine range as far as Tuscany. In 1549 the Swiss Confederation took its place among the mountain heights, whence it has never been dislodged. In Napoleon's time it became a part of the Confederation of the Rhine but came forth in the reconstruction of Europe in 1815, never, we may hope, to be thrown down from its high seat.

Thus the great range has never been a boundary in the strict sense of delimiting two nations which came up to either of its great lines of water parting. If we examine the Alps today we find them as an ideal boundary only between France and Italy. Switzerland occupies the central heights without unity of race or language. It thrusts a tongue southward among the Italian lakes without a shadow of geographic reason and projects into French territory past Lake Geneva in equally arbitrary fashion. In like manner it cuts off the upper waters of the Rhine and joins Austria along a meaningless frontier. Lyde avers that it is "too strong by natural features and human type for any of its neighbors to be permanently dangerous to it."[10] One may question this assurance and may well doubt whether

[8] D. W. Freshfield: The Great Passes of the Western and Central Alps. *Geogr. Journ.*, Vol. 49, 1917, pp. 2-26; reference on p. 5.

[9] Leon Dominian: The Frontiers of Language and Nationality in Europe, New York, 1917, p. 333.

[10] Article cited in footnote 1, p. 134.

the considerations cited fully explain the German failure to cross Swiss territory. At all events Switzerland for a short section of the Alps fills the rôle of a buffer state. The Italian struggle with Austria will result in making the great mountain arc more nearly a precise boundary than it ever has been in the course of European history.

The English Channel and the North Sea

One might hold, with large show of reason, that the English Channel has been the most effective of all historic boundaries. It has undergone the test of centuries, and the island kingdom stands forth needing no argument. Before we pass to particulars, we may summarize our conclusion by asking if there would have been immunity from invasion in all modern times if we could imagine an interchange of population types between Great Britain (in the strict meaning of the term) and Ireland. In this manner we inquire concerning the relative protective value of the national spirit and the geographic situation. We shall make no pretense to a quantitative answer, for here comes in geographic influence, which has no doubt had its share in molding the nations to defensive strength.

The English Channel and the North Sea (the latter hardly now to be called the German Ocean) did not prevent the Romans from invading and organizing the larger part of the greater island. They were ineffective barriers for centuries against the thieving pirates and tough-handed immigrants who rocked across the waters from the German coast lands, from Jutland, and from the Norwegian fiords, to become the heralded ancestors of Englishmen and New Englishmen. England was successfully invaded in 1066 but never since that remote time. Here we seem to belie our observation that boundaries were specially efficient in primitive days.

Let us come back to the power of environment and, using Lyde's phrase, recognize in the British water frontier a "racial agent," a force or, better, a condition, which helped to make and weld and develop a people, truly a world power. Here were a climate, a soil, a fishing zone, an outfit of minerals, and a defensive water barrier, which encouraged and protected development. Being in the realm of human geography, with emphasis on the human, we put with environment a fortunate gathering of the raw material of civilization, the marauding Angle, Saxon, Dane, and Viking, Teutonic if we must admit it, but as far today from the Teutonic evolution of the Continent as if the Straits of Dover were the Atlantic Ocean.

Here have grown industry, invention, national unity, and the love and power of liberty. As a sea barrier has promoted these ends it may be said to have been efficient in defense; however it be, the kingdom has stood free from the foul clutch of the invader for eight hundred and fifty years because in defensive power, centering in the human spirit, she has more than stood even with any power of aggression.

Our conclusion thus far is that defensive boundaries, as observed in his-

tory and as seen in a regional survey of the world today, are few, even in the most highly differentiated regions of all, the continent of Europe. And the few boundaries of distinct efficiency show such limitations that we have no warrant for reliance on them in present settlements or for future generations.

Human Factors in Boundary Making

Race

Emphasis lies today on the human factors in boundary making. The word "race" has been much used in this field but deserves to be discarded. All the great nations and many of the smaller are composite in origin, and it is the nation—not the race—that is looking for ring fences. The German may be Teuton, Slav, or Alpine; long head, round head, brunet, or blond; he is a member, for boundary purposes, not of a race, but of a nation. South Germany has been deemed by good authority to be less Teutonic than eastern France.

Language

Nor is language a criterion for the boundary maker. Professor Spenser Wilkinson, in discussing Lyde's paper on boundaries before the Royal Geographical Society, recalled a Greek lady who, in the course of a day's travel in the Balkans, denied that Bulgarian speech necessarily made the speaker Bulgarian. Greeks some of them were in all but speech—"the test of nationality is the will of each." Nationality is the criterion, and men may elect their nationality just as they choose the town they will live in and the business they will pursue. Belgium, bilingual; Switzerland, quadrilingual; and Alsace-Lorraine, with French sympathy and German speech, are examples which in these days need but to be named.

Nationality

Nationality means unity of ideal, derived chiefly from hereditary experience or from geographical environment or more often perhaps from both combined. It is the group which wishes to live and act together and to have a common government, embodying its purpose and its emotion in the word patriotism. National feeling is tied up with primitive heroism, or the sage wisdom of the fathers, which preserved the group from destruction; it embodies itself in song and folklore. These heritages gather about sacred pieces of ground, the altar spots of the homeland, and they build themselves into constitutions and laws, into literature, into social customs, distinctive dress, and forms of art. With these cherished things go too often an unreasoning isolation and an absurd and dangerous repugnance to the foreigner and his ways. "The men who compose a single nation must think together." "Belgium is fathomed in their hearts." "Serbia extends as far as her folk songs are heard." Thus, with poetic feeling,

does Dominian compress into terse sentences the essence of nationality. A nation, then, is a group loving its own soil, devoted to its ways of living, proud of its history, sure of its destiny. A home, a life, and the will to live and to die if need be in order to preserve them—such is nationality.

Expansion of Prolific Peoples

Nations grow, and in the expansion of prolific peoples the boundary maker meets his most stubborn problem. It has been solved by force; but the world that is, and that is to be, will not willingly meet the question in that way. Human distribution follows to a degree the analogies of biology. Men spread like oysters, chestnuts, fishes, and birds, into environments that favor comfort and perpetuate their kind. The principles of migration, struggle, and adjustment find application in human history. Human groups cannot be put into tight compartments any more successfully than can other creatures. The great northern forest of North America projects a peninsula of its own species far south on the crest of the Appalachians. The Pacific Coast forest has a great enclave among the typical forests of the Canadian Rockies, and all types of forest shade into one another. Such is the distribution of all faunas and floras, fossil and living. So much is to be said for man in his relation to other living things; we inherit an evolutionary condition. Must we therefore apply the law of the jungle to civilization? A great nation, basing its science, as it based its history, its philosophy, and its religion, on its desires, decided that war is a "biological necessity." It fought to get room for increasing numbers. Even Sir Thomas Holdich admits that boundaries are violated by an "irrepressible demand for more space for an expanding people."[11] Can the world admit this procedure? We recognize it in the case of small or primitive populations, as in early America, but what are its limitations among civilized peoples? Must a high birth rate be regarded as giving title to a neighbor's estates? Again Holdich refers to the "right of expansion" to meet the imperious demand of multiplying people as promotive of dispute and war as long as the world lasts. This surely is a hard saying. We cannot indeed expect to regulate population output by an international convention, but perhaps we can regulate international conduct for peoples who convert their domain into a human stock farm. Even Dominian allows that the *Drang nach Osten* is inevitable, because the East is thinly populated and fertile. But this does not answer the question whether the penetration should be imperial and militaristic, or individual and peaceful. If the world is to exist, and if invention is not to proceed to the self-destruction of the race, we must find peaceful ways of caring for growing populations. We cannot pull up line fences while our neighbors sleep and then kill them for resisting in the morning. No writer has put this imperative of the future better than Professor Lyde.

[11] Article cited in footnote 3.

"The natural growth of the national unit justifies geographical expansion only in primitive times and places. Even so, as all empty spaces must some day be fully occupied, territorial expansion is only a temporary means of shirking obligations. Certainly in a mature civilization natural growth can be legitimately met only by intensive, not by extensive development—at all events inside that area of mature civilization."[12]

Expansion Through Greed and Ambition

Economic greed and dynastic ambition have used the common human passion for bigness as an argument for territorial expansion. Let us conquer and add territory. We need rich colonial possessions that we may have raw materials and enlarge our markets. It is for the economist to formulate the answer, and it would be significant in boundary determinations. As recognized by more and more of the world at this time, the true end of nations and governments is the well-being of the individual. Is the economic position of a small nation in a decent world worse than that of a great nation? And does the individual man, or the special industry, have as good a chance in a small as in a large nation? If there is, or can be, equal opportunity to realize the true ends of life, a strong motive for tearing up boundaries is put to rest.

We do not attempt the answer. We may, however, observe that the Swiss seem as happy and prosperous, by all decent standards, as British, French, or Americans. The quality of loyalty is not set by the bigness of one's country, rather in the love of its institutions, devotion to its physical associations, pride in its achievements, and satisfaction in the comfort and opportunity which it offers. It may be, after all, that the meek shall inherit the earth—a German today may well envy a Dane or even a Cuban.

Losses by Emigration

Here belongs the alleged loss of the emigrant who goes out from the homeland and naturalizes himself under another flag. Out of this view which regards alienation as a subtraction from the legitimate resources of a nation, arise propaganda, espionage, mental reservation, double allegiance, that ugly brood of policies devised to build up *Deutschtum* in America, colonies in South America, and extension of dominion everywhere. Which would have been a greater boon to Germany—a large body of emigrants becoming loyal Brazilian citizens, retaining kindly memories of the Fatherland, and fostering friendly trade; or a collection of aliens maintaining a solid block of language, drilling at arms and plotting to put a blotch of German color on the map of the southern continent? Britons have gone to the United States, to Canada, to Australia, to South Africa, with godspeeds and no grudging, with consequences to the motherland now self-revealed and glorious. A seed of personality, of industry, thrift, and

[12] L. W. Lyde: Some Frontiers of Tomorrow, London, 1915, p. 12.

liberty blown on the wind of chance and rooted in the farthest corner of the world does not make the home country poor. When the world learns the lesson of mutuality it will have cleared the worst tangles in its boundary problems.

Boundaries for Economic Equilibrium

There is a school of writers who base their conclusions on a so-called economic interpretation of history and call for countries outlined as natural economic units having a considerable degree of self-sufficiency in resources and trade opportunities. In their view small nations do not much count if they stand in the way of big neighbors. Mr. Simon N. Patten, of the University of Pennsylvania, is an apostle of this doctrine. His views of the "unnatural boundaries of European states" and of a scheme of reconstruction can best be told in his own language, which even in excerpts appears to do him no injustice. "Old tradition persists, and ideas of political freedom based on former conditions demand small states. Economic progress, however, makes larger states inevitable now that the world's resources are to be exploited in more effective ways." We are forced to conclude that former conditions, home, traditions, constitutions, customs, patriotism, count for nothing and that man ought to live by bread alone. "Germans sacrifice so much for their country because they see an even more degraded Germany looming up as a result of defeat." "Germany is admittedly in a position where her present boundaries act as a hindrance to her industrial development and a bar to her social progress. Her natural seaports are in Holland and Belgium." "Shall race feeling or economic interest dictate the formation of boundaries?" "Germany suffers a similar wrong when she is kept from the North Sea and a permanent commercial union with Holland and North Belgium." "The masses of the people would grow more contented as their prosperity and security were assured, and would soon become callous to those reactionary appeals to the emotions that now make so much trouble for the world." "Scientific boundaries could easily be arranged that would bind together the people within them and make these inhabitants generous and sympathetic to those outside of them. Moreover such zone boundaries are easy to draw in Europe, as the natural features that fix them are so pronounced." "Belgium is an artificial state created out of the whole cloth with no regard to social or economic consideration. Only a false enthusiasm for small political units gives any ground for its continuation."[13] Of the above sentiments, a geographer has only this to say: that they represent an alleged principle of boundary making; that social philosophers have missed the recipe for making men good and contented; and that further criticism either from the social or the geographic point of view is unnecessary.

[13] Unnatural Boundaries of European States, *Survey*, Vol. 34, 1915, pp. 24-32.

Present problems are an inheritance from the migrations, expansion, and conquests of the historic past, and the new map cannot be beaten into conformity with abstract theories. Making up countries by rule is as impracticable as any radical socialist program for individual prosperity.

Specific Problems of Europe

It is not within the scope of this article to discuss, beyond bare reference, the new map of Europe. Map makers, however, must take account of the principles which we have attempted to place in order. Certain applications of these principles may be briefly examined. The author has made it clear that with certain reservations he is more in sympathy with the Lyde type of doctrine than with that so ably urged by Holdich. With modern appliances for aggression, the world must put its faith in the decent behavior of nations; but the nations must for a time, and perhaps for a long time, be prepared to supplement this faith by co-operative militant action. It is pessimistic and unthinkable to settle down to the Prussian principle of world order.

France

The simplest survey of the map of France shows the futility of the ring fence as a safeguard of her liberty. She is bordered by four seas and cannot defend herself, unassociated, from any pirate navy that is permitted to roam them. It is no violent hypothesis that Swiss neutrality should have been violated and that Italy should have been forced into military co-operation as a member of the Triple Alliance. In the light of such possibilities examine the French east front. The Belgian plain, protected by treaty and by the forts of Liège, have their own story. The Verdun gap was held by the blood of Frenchmen. There would still have been open the Belfort gap, the Geneva-Rhone route, the passes of the Savoyan Alps, and the coast gate of the Riviera. It is idle to talk of the Ardennes, the Vosges, the Alps, the Pyrenees, and the sea as protecting France. One of the most eminent of French geographers has said, speaking of the land border, that his country was "encircled but not imprisoned." He might have said "surrounded but not protected."

Poland

Even worse is the barrier theory for the new Poland. This unhappy country appears on the map at least as early as the time of the First Crusade, bordered by Pomerania, Bohemia, Hungary, and Russia. Then the Carpathians were its southern boundary. Similar was the status two centuries later with even longer frontage on the Carpathians. There was vast extension in the sixteenth century when Poland came to the Baltic between Pomerania and the Teutonic Order, including in the south the

present Galicia. Succeeding centuries saw wide conquest and withdrawal on the vague plains of the east, until the consummation of the great international spoliation of 1795. Could Poland have saved herself if she had had good geographic barriers? The answer lies in the Romanoff, Hapsburg, and Hohenzollern dynasties. No physical features can make him safe who dwells among thieves. Can scientific boundaries be drawn now to protect the suffering millions of Poland? Let the schoolboy and the reader of the newspaper war map answer.

Coastal Veneers of the Baltic and the Near East

We cite one further class of examples and attempt to apply the barrier theory. Mackinder in his own vivid manner has described the coastal veneers of the Baltic, the Adriatic, and the Aegean Seas. On the Baltic is a veneer of Germans in East Prussia backed by a hinterland of Poles. On the Adriatic is a veneer of Italians fronting the solid mass of Yugo-Slavs and offering one of the toughest problems of the settlement soon to be made. At Saloniki are Greeks, and in the valleys that lead down to the Aegean border are Bulgarians. Similar is the distribution of Greek and Turk east of the Aegean. Such are the tests by which the barrier theory is met, and in these tests it is found wanting. We are thrown back upon the will, upon mutual concessions, upon assimilation, favored by democratic governments, and no doubt upon a residuum of physical restraint exercised upon those who disdain moral control. We gather our conclusions in the following paragraphs.

Conclusions

The present arrangement of human groups is a heritage from long-existing biological conditions of dispersal, migration, and intermingling, complicated by the vagaries of the human will, as seen in lust of conquest, love of war, dynastic ambitions, and economic greed.

The necessity of boundary lines has come with the filling of the world's spaces, the pressure of population on resources, and the lifting and widening of the material standards of living.

We hold with Lyde that civilization is "progress in the art of living together." Any nation is partial and backward in civilization in proportion as its standards of international dealing fall below its laws of intranational conduct.

We do not accept Holdich's virtual admission that international ethics are permanently so low that defensive boundaries will always be essential to reasonable safety against attack.

On the other hand we are not convinced that boundaries should be deliberately and always placed where people meet. We would not avoid such lines if the greater justice to the greater number on both sides of the proposed fence seems to require them. We might for the present give

questionable or quarrelsome neighbors as high a fence as is practicable, as we try to keep the weak of all sorts from overpressing temptation.

Approximately twenty-five human groups in Europe show such unity of purpose and ideal, such community of interest, of history, and of hopes, and each in such reasonable numbers, that they have embarked or deserve to embark on a career of nationality.

The world is now pretty well agreed that ruling houses are obsolete, that the interests of great powers are no more valid than those of small powers, and that economic equilibrium or self-sufficiency in natural resources does not outweigh the rights and desires of any truly national group.

Europe has an exceptional number of physical units which in primitive days could serve as the cradles of nations. In the advanced conditions and high densities of today, however, the number of physical compartments falls far short of the number of groups which properly wish independence.

Modern appliances for war have impaired the security once gained through physical barriers. Heights of land and all kinds of waters give important aid in war, but they do not fend off war. We cannot "destroy the germs of frontier dispute by drawing physical boundaries."

We must draw boundaries on defensible or separating lines if possible but at all events in such a way as to work substantial justice.

Here is the sphere of a league of nations, embodying the will of all mature civilization that imperfectly civilized groups shall no longer make biological inferences or blasphemous conceptions of divine destiny the excuse for perpetuating tooth-and-claw methods in the relations of peoples.

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THE NORTHEASTERN MINNESOTA FOREST FIRES OF OCTOBER 12, 1918*

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Compared with other great conflagrations of historical record, the fires which swept over northeastern Minnesota during the afternoon and night of Saturday, October 12, 1918, will easily take rank among those of exceptional character as to area, rapidity of travel, loss of life and property, and general devastation in the regions affected.

The Burned Areas and the Losses

In this most recent of Minnesota's holocausts over 8,000 square miles were affected, and approximately 2,000 square miles of territory, mainly within a radius of 50 to 100 miles of Duluth, were more or less completely burned over, including great tracts of forest—mostly second growth and consisting largely of white pine, tamarack, and birch, as well as vast quantities of cord wood—farm buildings, settlers' homes, whole villages and one small city, suburban portions of Duluth, and summer homes or cottages and hunting and fishing lodges in the outlying districts. These burned sections (see map, Fig. 1) include parts of St. Louis, Carlton, Pine, Aitkin, Itasca, Cass, and Crow Wing Counties, together with tracts adjoining Superior in Douglas County, Wisconsin, opposite the southwestern suburbs of Duluth. The greatest damage occurred in St. Louis and Carlton Counties. The following places were either ravaged somewhat or partially or wholly destroyed: Adolph, Aitkin, Arnold, Autumba, Bain, Brookston, Bruno, Caribou Lake, Cloquet, Cloverton, Corona, Cromwell, Exeter Farms, Five Corners, Floodwood, Fond du Lac Indian Reservation, Grand Lake, Harney, Hermantown, Kettle River, Lakewood, McGregor, Maple Grove, Moose Lake, Munger, Pike Lake, Saginaw, Sturgeon Lake, Tamarack, Twig, Wawini, and Willow River, while the affected suburbs of Duluth included most of northwestern Woodland, the Calvary Road district, and portions of Lakeside and Lester Park. Nearly 400 persons lost their lives, about 2,000 were more or less seriously burned, and about 13,000 rendered homeless. The loss of live stock was heavy, while the property losses (including several million feet of standing timber, largely second growth, as stated) may reach or exceed $25,000,000 in value, nearly $4,000,000 of the losses occurring in St. Louis County, probably not more than one-fourth of the total being covered by insurance. It will require a painstaking and expert survey ex-

* A brief preliminary note (with map) on this conflagration, based on the newspaper reports of the time, was published in the December, 1918, *Review* (pp. 513-514). The presented extended account and detailed map (Fig. 1) are based on the accurate data since become available.—Edit. Note.

tending over many months definitely to establish the figures. A fair estimate of the property loss can be based on the statements made by local officials of the Relief Commission at the time to the effect that approximately $5,000,000 would be needed properly to meet the requirements of temporary assistance and probably $20,000,000 for a semblance of permanent rehabilitation. Between 40,000 and 50,000 persons were affected in one way and another by the fire.

Character of the Fire

At the outset it must be borne in mind that this was not merely one great fire, but fifty to seventy-five or more which united to a considerable extent, were fanned to huge proportions by the wind, and then, with the increasing energy developed by the consequent violent air movement attending rapid combustion on such an enormous scale, advanced over vast areas with almost incredible speed.

Predisposing Factors

For some days before the great fires in question there had been numerous brush and peat-bog fires burning over limited patches. These were directly traceable to various causes, such as carelessness on the part of campers, automobilists, and train crews and on the part of farmers and settlers in burning brush to clear land. Such fires are quite common to this section, especially during the dry periods in summer and autumn, and the public in general does not ordinarily regard them seriously. The conditions which favored the full development of the great fires were primarily those of drought (the season being the driest for 48 years) and the fresh winds that occurred on October 12.

General Meteorological Conditions

Except for the continuance of the dry weather the general meteorological conditions on the morning of October 12 were not unusual for the season. The weather map, based on the 8 A. M. observations of that date (Fig. 2), showed a low barometric pressure area of moderate strength centered over western Ontario, the inclosing isobar being 29.6 inches (corrected to sea-level pressure), and an area of high barometer of 30.2 inches extending from Wyoming, Utah, and Nevada to Washington, so that the air-pressure gradient was by no means extraordinary. Fair weather and winds from westerly directions, fresh or moderately strong (about 30-mile an hour rates), were indicated, and in addition a "small craft" wind warning was ordered displayed on western Lake Superior at 10:30 A. M. All of this was given the usual publicity.

Wind Velocities at Duluth

At Duluth the weather was clear until about 12:30 P. M., when smoke began moving in from westerly sources; but, because of the occasional

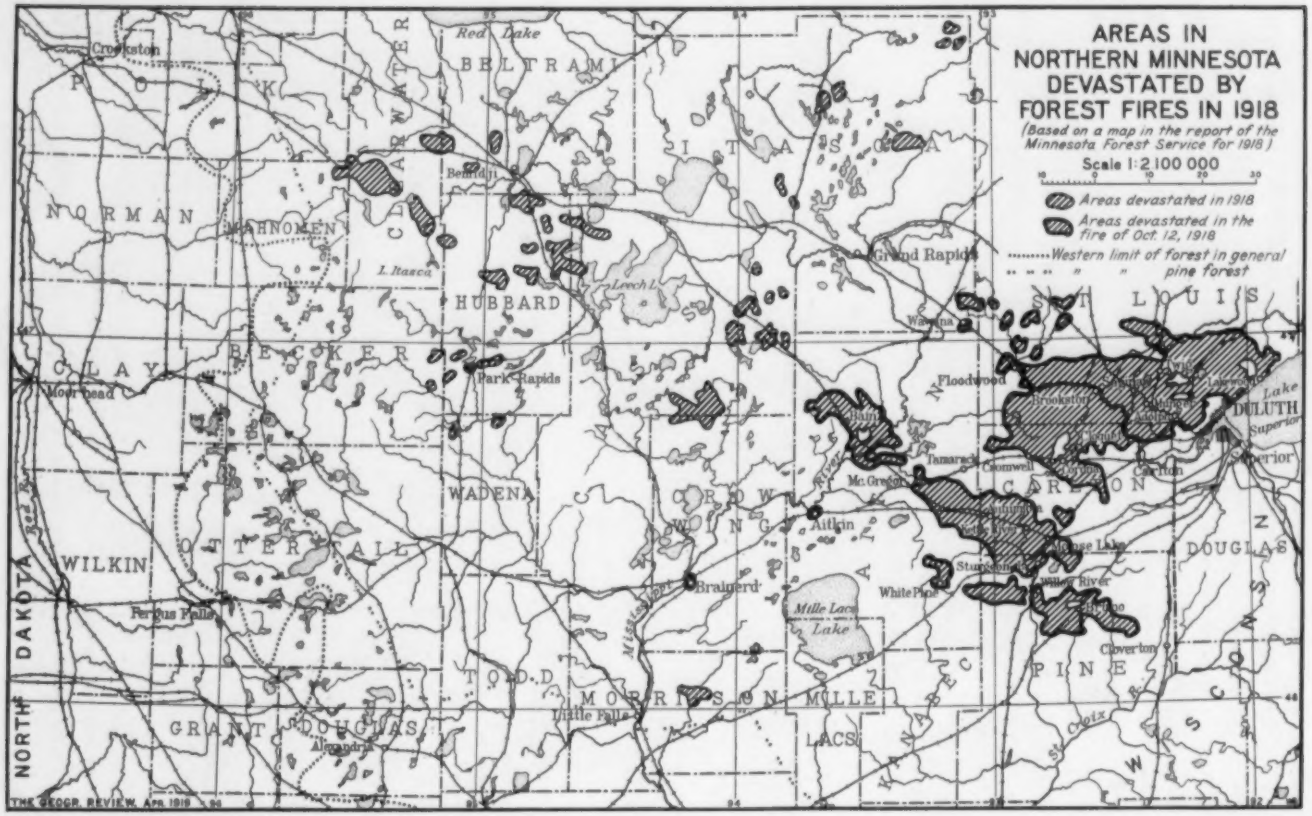

FIG. 1—Map of northern Minnesota showing the areas devastated by forest fires in 1918. Scale, 1:2,100,000. The western forest limits are based on a map by Upham and Butters (reproduced in *Minnesota Geol. Survey Bulls. 12 and 13*, 1915 and 1917).

previous occurrence of such a condition, the smoke attracted little attention. After 2:30 P. M. it increased considerably, the sun appearing red or being altogether obscured most of the time thereafter—a manifestation common to fires of unusual character. The wind gradually increased also, reaching 30 to 40-mile rates from the west at times until about 3 P. M. (Fig. 3). After that hour there was a steady rise to gale proportions, 50 to 60-mile rates from the west-southwest-northwest occurring between 4:15 P. M. and 9 P. M. After this hour the wind continued at 40-mile velocities until about

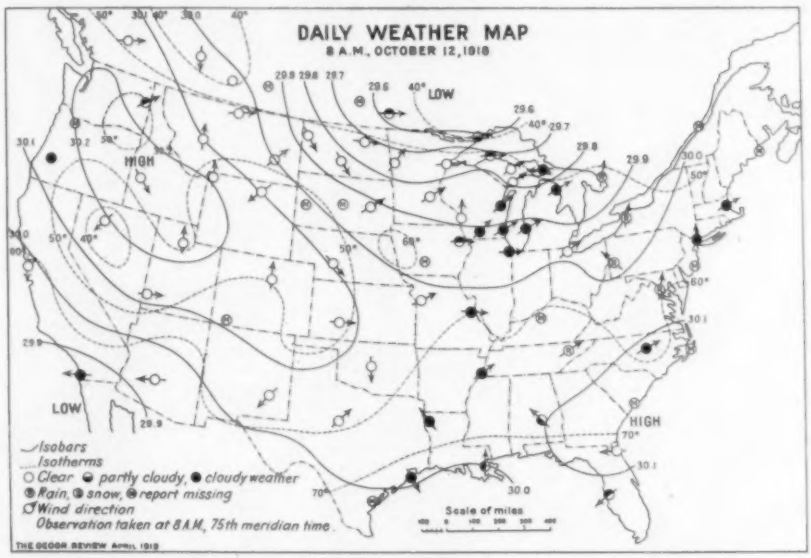

FIG. 2—Copy of the daily weather map of the U. S. Weather Bureau for October 12, 1918, issued at Duluth, Minn. Scale, 1:42,000,000.

2 A. M. of the 13th, subsiding materially thereafter. The highest 5-minute rate was 65 miles an hour from the west at 5:52 P. M., while the extreme speed for a less period was 76 miles about that time.

THE FIRE AT DULUTH AND ITS ENVIRONS

Between 4 P. M. and 5 P. M. very dense volumes of smoke drifted rapidly in from the west, showing that fires of marked intensity and extent were occurring in the vicinity. Between 4 P. M. and 6 P. M. rather alarming reports began to reach Duluth. In spite of all this many people left about that time for week-end visits to cottages on nearby lakes or cabins in clearings. Occasionally during the late afternoon and far into the night the dense smoke[1] showed deep red color at points from south by way of west

[1] For an account of the diffusion of the smoke clouds from the Minnesota forest fires over a large portion of the United States east of the Missouri River, see the note under "Geographical Record" in this issue.—EDIT. NOTE.

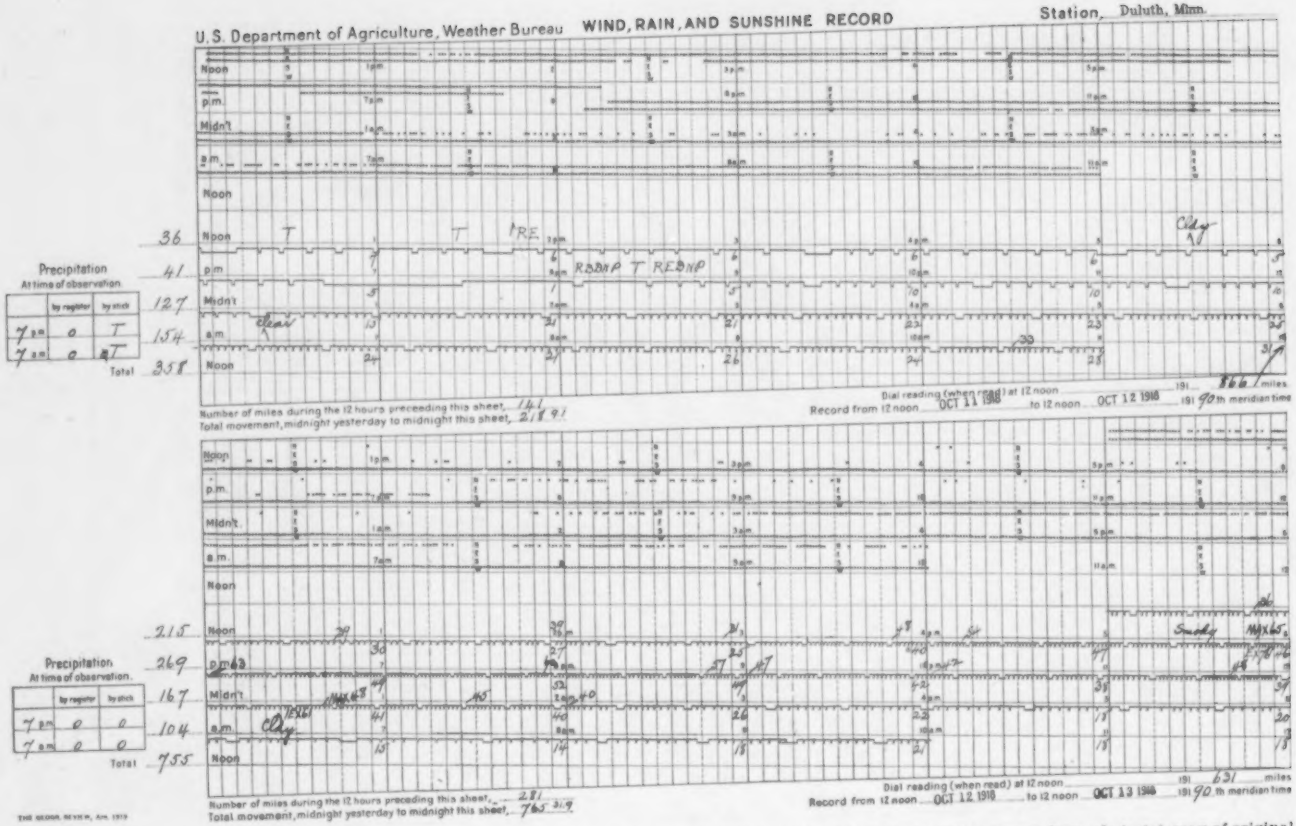

FIG. 3—Wind direction and velocity record at Duluth, Minn., from noon on October 11, 1918, to noon on October 13, 1918 (redrawn from photostat copy of original record). For explanation see bottom of opposite page.

to north. About 5:30 P. M. realization of the danger began to dawn when authentic news of disaster in adjoining districts began reaching the city. Brookston (about 35 miles west of Duluth) was destroyed at 4 P. M., and after the belated report of this calamity events moved swiftly. Telephone and telegraph lines to the southwest, west, and northwest were more or less demoralized or down by 6 P. M. and generally so after that hour.

At 6 P. M., as fires were beginning to menace Woodland (a northern suburb of Duluth), the fire department called upon the military forces for help in fighting the fire and in rescue work. By 7 P. M. companies A, B, C, and D of the Home Guard, C and D of the 4th Minnesota Infantry, and A and B of the Motor Corps were fully mobilized and in action. They were assisted by thousands of volunteer citizens, many of them aiding with their automobiles. All night long these men and also many women toiled with the utmost energy and fortitude, rescuing the helpless, fighting fire, and saving property where possible. Many of the soldiers continued on duty from 36 to 48 hours without rest, and for nearly two weeks hundreds of them kept up the work of rescuing life, guarding property, and patrolling the fire zone.

Unlimited praise is due the soldiers, motor corps, train crews, and volunteer citizens. The whole country was searched for days as thoroughly as practicable. Otherwise thousands of people would have perished. The automobile rescue work on the night of the 12th was rendered especially hazardous by reason of the necessity of speed at a time when even to use lights was almost futile because of the dense, suffocating, and blinding smoke and the flying sparks and brands. Quite often there would be flames on both sides of the road. Many accidents were caused by collisions and ditching of automobiles. Many of the rescuers had to abandon their cars and flee for their lives. Fully one hundred automobiles were thus destroyed, and a very large number were badly damaged. Some of the relief trains also ran through sections where there were roaring and terrifying conflagrations on all sides. There were innumerable instances of the most splendid heroism and the noblest self-sacrifice. No danger was too great. It was a sublime exemplification of true Americanism in a time of gravest peril.

There were all kinds of alarming rumors, of course; but it was well established by midnight of the 12th that huge sections of the neighboring country were in flames or already in ashes and that many towns and villages had been damaged if not wholly destroyed, with consequent loss of life.

EXPLANATION OF FIG. 3—The vertical lines indicate 5-minute intervals. The dots in the upper part of each of the two sections of the record show the direction from which the wind was blowing each minute, the level of the dot-lines (defined by the letters N. E. S. W.) indicating the components of the four points of the compass which went to make up the wind direction at a given moment. The wind velocity is shown in the dentated line in the lower part of the record, each dentation representing a velocity of one mile within the time indicated. The hand-written figures in the velocity record show the total number of miles recorded in the hour and the maximum velocities, respectively. Maximum velocities are for 5-minute periods, and rates less than 30 miles per hour are not indicated in this case. As the time is indicated for both direction and velocity it is easy to associate the two. Note the high velocities between 5.35 P.M. and 9.00 P.M., on October 12, especially near 6.00 P.M.

FIG. 4—Partial view of Cloquet, Minn., showing completely devastated residence district as it appeared two days after the fire of October 12, 1918. A portion of the destroyed business section appears in the distance at the left. (Photo by H. McKenzie.)

Extent and Nature of the Devastation

The various fires traveled fast, as much as 15 to 20 miles an hour and at even higher speed in some cases. At Moose Lake the fire frontage was about 7 miles in extent, at Arthyde 3 miles, at Corona 4 miles, and at Cloquet 6 to 8 miles, while near Duluth from west to north and including the northern suburbs there was an irregular frontage of fully 10 miles. Occasionally vast billows of detached flame would leap across rivers, streams, small lakes, roads, and other open spaces in front of the walls of fire. An interesting feature observed in a few instances was that, as the main fires advanced or moved about, there were back-firing effects which eventually caused some of them to die out. This was a phenomenon attending the fire itself and has no reference to the methods of back-firing usually practiced. Human efforts of this sort were generally unavailing during the worst of the fire storm, but where such work was done sufficiently in advance it was fairly effective. The greatest devastation occurred during the height of the 50 to 60-mile westerly gale, between 4 P. M. and 9 P. M.

Moose Lake, in Carlton County, about 50 miles southwest of Duluth, had probably the largest proportionate loss of life, 200 being burned to death in that locality. Later 87 charred bodies (many unidentified) were interred there in one large trench grave.

Cloquet (8,000 population), in Carlton County, about 25 miles west-southwest of Duluth, suffered the most complete fire loss. The property destruction in the residence and business sections was practically total (Fig. 4), but most of the lumber and paper mills remained without serious damage. A remarkable feature is that but five lives were lost in what constituted the city limits. By the quick action and good management of the railroad people and prominent citizens practically the whole population was safely moved out in about two hours, mostly to Duluth and Superior. Passenger coaches, box cars, flat cars, and coal cars were utilized and made up in several long trains, the cars being packed to capacity and their occupants carrying little or no baggage. The station was in flames as the last train departed. Great numbers also left in automobiles and other conveyances and even on foot, taking the road to Carlton, six miles distant, which proved a safe refuge. Fully one hundred lives were lost in the district adjacent to Cloquet.

Settlers and farmers and townspeople saw the product of their years of toil and thrift swept away in a few moments. Thousands of prosperous citizens were rendered destitute. This was quite the common experience, although some were fortunate in having insurance. In spite of all the misery and loss a fine courage and a general optimism prevailed, and reestablishment was soon progressing.

Loss of Animal Life

The dairy interests suffered enormous loss. Large numbers of horses, cattle, pigs, poultry, dogs, and wild game such as deer and rabbits, were

burned, and even fish in some of the shallower streams are reported killed. Free veterinary aid was furnished to injured stock as far as practicable. In some of the outlying settlements timber wolves were later reported as becoming numerous and destructive to remaining and unprotected live stock.

Damage to Roads

Immense damage resulted to roads—especially those crossing marshlands, peat bogs, and muskegs. A vast number of bridges and culverts had to be replaced. The need of such repairs greatly retarded relief work. Rural mail routes were disorganized and service could only gradually be resumed.

Human Tragedies

The pitiful tragedies and thrilling escapes reported were so numerous that any attempt at detailed description of them would fill a volume. In some instances whole families lost their lives; in others the parents were survived by the very young; or in still others only the very old or the crippled or the badly burned were saved. There were numerous instances of premature childbirth, sometimes under most distressing circumstances, and literally hundreds of similar heartrending experiences. In one case a man lost his wife, his children, and all his immediate relatives—a total of 18 persons; all were buried in one grave. The fires came so swiftly that many people escaped only after the most heroic efforts and terrifying hardships. Scores saved themselves by plunging into lakes and streams or by lying face downward in ditches or other depressions. Many such were almost suffocated by the smoke or were badly burned; others were actually drowned; and still others were first suffocated and then burned beyond identification. Some victims were actually burned to death while asleep in their beds.

For the most part the damage in the burned areas was in the nature of annihilation. The desolation was of an altogether weird and depressing character, reminding one of Doré's illustrations of Dante's Inferno.

Freaks of the Fire

The fires played strange tricks. On one side of a road there would be nothing but a charred tangle of fallen or partly fallen tree trunks, or a mass of ashes extending for miles with here and there a stump or boulder showing, while on the opposite side for the distance of a mile or more trees and shrubbery and grass would be untouched. A house and barn would be burned to ashes while between the two might stand an undamaged haystack. Occasionally houses were left intact while all around would be desolation; or perhaps one small area of forest might be left inviolate while for miles in all directions nothing but burned waste could be seen. In some cases in the thoroughly burned districts poultry, pigs, dogs, cattle, or horses

would be found wandering disconsolately about the ruins of their former comfortable domiciles. How under the circumstances any of these animals escaped unscathed is one of the mysteries.

Relief Measures

The fire situation was well in hand by October 14, and on the 19th copious rains effectually disposed of smoldering embers which had continued a menace.

The rescue and relief measures were immediate; they were exceptionally well organized, splendidly generous, and sympathetic. The temporary relief included a rationing scheme for the sufferers and for live stock, supplies of fuel, and even moderate sums of money regularly furnished. Thousands of articles of clothing and household and farm equipment were distributed, all free. This work was carried on by the Relief Commission under the direct supervision of the Red Cross, with headquarters at the Armory in Duluth, while other organizations rendered splendid service of the same kind in co-operation with the Red Cross. Hundreds of the simplest form of emergency houses and barns, and in some instances community barns, were built. After the fire a hundred or more automobiles and autotrucks were engaged in searching the countryside for casualties and for people in distress. Thousands of bushels of potatoes were dug and stored, and much temporary shelter construction was done by volunteers. Every effort was made to provide employment for the vast number of refugees. Arrangements were also begun to procure seed either free or at cost to settlers and farmers for spring planting. The subjects of abatement of taxes and re-establishment of land surveys and titles likewise received attention from the authorities.

Effect of the Fire on the Soil

In the opinion of local authorities, men of long experience and practical knowledge of similar events, the recent fires have done little if any damage to the soil. The prevailing idea is that the large quantities of burned vegetation (especially wood, on account of its potash content) will be beneficial rather than harmful, particularly where the burning was rapid and not too deep, and that the extensive and thorough burning will facilitate land clearing. Commenting upon the idea among settlers that peat lands are improved by burning and that this belief is the cause of many settlers' fires, an official of the Forest Service of the U. S. Department of Agriculture states that fires in peat lands are hard to control and expresses the fear that if these fires are allowed to continue to burn in the peat lands down to the white sands, as was the case in the big fire near McGregor, it will be but a matter of time until Minnesota will have a moving sand-dune problem, like Nebraska.

Cause of the High Wind

Careful consideration of the available facts seems to warrant the conclusion that the major force of the gale which prevailed during the late afternoon and night of October 12 was fire-created. As has been previously stated, the weather map on the morning of that date apparently favored wind velocities not much in excess of 30-mile rates. But, inasmuch as numerous small fires were then prevailing over extensive but more or less

Fig. 5—Scene near Duluth showing trees uprooted by the fire gale on October 12, 1918. The effect of the various fires was comparable to that of a grate fire of enormous proportions, and in their immediate vicinity there was an accompanying air movement or combustive draft of hurricane force that probably attained a velocity of 80 to 90 miles an hour. Burned residence in middle ground. Distant view obscured by smoke from smoldering debris. Photo taken October 13, 1918, camera facing east-southeast. (Photo by H. McKenzie.)

separated areas, and as the record-breaking drought had caused a tinder-dry condition of vegetation, a wind of any sustained force was all that was required to put into activity a series of united conflagrations that gathered tremendous impetus and quickly thwarted the most desperate attempts at effective control. Reliable reports show that in the immediate vicinity of the big fires the effect was comparable to a grate fire of enormous proportions; that there was an accompanying air movement or combustive draft of hurricane force; that the wind velocity was immeasurably greater in the immediate vicinity of the fires than it was a few miles distant, as in Duluth; and that there was a very noticeable decrease of wind from the fire zone outward. It has been estimated by some that while the wind at the Weather Bureau Station was blowing at the rate of 60 miles an hour it

must surely have been blowing at a rate of 80 to 90 miles adjoining the fire fronts from two to six miles or more distant from the station. There was an attendant deafening roar of fire and wind combined. In numerous instances people were thrown flat on the ground, and some automobiles were overturned by the wind in the vicinity of the fires. There are no authenticated cases of such accidents as these at the time except near the fire fronts. In many instances the rescue automobile engines and radiators were found to be clogged or covered with quantities of sand and gravel blown upon them in the fire districts. This sort of trouble was not experienced elsewhere during that period.

Reasons for Seriousness of the Fire

Indirectly the fire losses of life and property are believed to be largely due to inadequate forest ranger service, overdrainage of swamp lands and the lack of control gates for the drainage ditches, insufficient supervision and control of land-clearing and logging operations (particularly as to brush burnings), insufficient forestry laws and inability to enforce existing laws and to locate and punish offenders, public ignorance of or indifference to forestry laws already enacted, and the difficulty of quickly warning people who live in isolated sections like northeastern Minnesota. The inadequacy of forest fire patrol is illustrated by the fact that, since the state forestry appropriations were reduced by legislative acts in 1915 and 1917, the service in the matter of personnel is so limited that one ranger must patrol from 700 to 1,200 or more square miles, that is anywhere from 20 to 50 townships. And this in an immense section of the state still very largely covered with forest growth and brush, where the cleared areas are generally small in comparison with the surrounding wild country.

Need of More Adequate Fire Protective Measures

As to the security afforded by proper fire patrol the State Forester, in a preliminary report regarding the recent catastrophe, says:

> With a sufficient number of rangers to see that burning is done only under proper restriction and control, and to see that any fires which may start accidentally or otherwise are promptly extinguished, there would be no opportunity for a big fire. Even during a high wind the starting of one fire is not likely to destroy a whole community. It is only when a fire has been allowed to burn long enough to attain a wide front, or when a number of small fires are close enough to unite easily, that settlements are seriously endangered. Neither of these conditions should ever exist, but to prevent them requires systematic patrol by a considerable force throughout the danger seasons. During this fire season the few rangers and patrolmen discovered and extinguished hundreds of fires. They arrested 60 persons and convicted 32.

Education, control, and force are needed to effect fire prevention. This of course should include warnings, but even the latter, when issued immediately before great danger of this kind, are usually quite futile, for, sad to relate, people are too often obsessed with a false sense of personal security

and immunity. Warnings, to be properly heeded, should be backed up with some sort of legal or moral penalty. The necessity for systematic propaganda of an educational nature is clearly obvious, especially as to protective measures. Legislative action is needed for more adequate forest ranger service, thorough supervision of brush or land-clearance burnings, and severe and enforced penalties for illegalities.

Last, but not by any means least in importance as a protective measure —possibly one of large pecuniary profit—clover and grass seed should be sown, and sheep and cattle should be put on these lands as fast as practicable. Such animals will not only keep down the weeds and rank grass, which at times are a fire menace, but will also provide wool, leather, meat, and dairy and other products which might easily become an important factor in helping to clothe and feed the world.

ALPINE FELL-FIELDS OF EASTERN NORTH AMERICA

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The *fjeld* of Norwegian geographers is a high, barren plateau, unfit for cultivation. The Dovre Fjeld is such a mountain plateau of the Scandinavian range, lying between latitudes 62° and 62½° in Norway and forming a continuation of the Kiölen Range. According to the Century Dictionary the word is the same as "fell" (from Middle English *fel, fell*, from Icelandic *fjall, fell* = Swedish *fjäll* = Danish *fjaeld*, a hill; perhaps connected with "field"). Plant geographers, such as Warming in the English edition of his "Oecology of Plants,"[1] render it as "fell-field," while Schröter[2] uses the term *Gesteinsfluren*. The German equivalent is *Felsenfluren*, and the Danish idea is expressed in the combination *Fjaeldmarker*. The idea of fell-field is a rocky flat, or plateau, situated in arctic or subarctic regions or on the alpine summits of mountains in northern as well as southern latitudes. The soil of a fell-field is not continuous but is broken by stones, rocks, boulders, rocky slabs, or outcropping ledges into pockets, crannies, or small areas circumscribed by the scattered or projecting rocks. Hence the surface of the fell-field is never completely covered with plants. Between the scattered patches of vegetation we see bare, pebbly, stony, sandy, or clayey soil usually devoid of humus in the ordinary acceptance of that term as meaning the organic material of the soil.

General Character of Fell-fields

Considerable attention has been paid to the fell-field formation by European phytogeographers, and our information on this subject has been summarized admirably by Eugen Warming.[3] He describes the subglacial, arctic, antarctic, and tropical fell-fields, as also those of the European mountains, and those of the mountain steppes, such as the *punas* of the Andes. According to Warming's summary the most characteristic feature of the vegetation of the fell-fields is the dwarfishness of the plants and the poverty of individuals covering the bare surface. The abundance of cryptogams, such as lichens and mosses, is noteworthy. The flora of these rocky flats may be considerably diversified, one species rarely predominating. The seed plants assume the cushion, or tufted, form and possess a perennial, strong tap-root which establishes itself in the soil pockets or descends considerable distances into the clefts or crannies between the rocks. Dwarf

[1] Eugen Warming: Oecology of Plants, Engl. transl., Oxford, 1909, p. 256.
[2] C. Schröter: Das Pflanzenleben der Alpen, Zurich, 1908, p. 503.
[3] *Op. cit.*, pp. 248-261.

shrubs occur, and these are mostly evergreen. The nanism, or dwarfishness, of the herbs and shrubs is associated with high winds, the shortness of the vegetative season, and the low temperature of the air and soil. The persistence of snow partially accounts for the low temperature. The illumination is more intense on the alpine fell-fields of European mountains and the Rocky Mountains and Sierra Nevada of America. It is a well-known fact that the intensity of direct sunlight, which inhibits the growth of alpine plants, increases with altitude, because the air is more rarefied and absolutely more dry. The fluctuation of the air temperature is greater on high mountain tops than on the plains at their base. The high winds of mountain summits have an intense drying action on plants, and, although the roots of the alpine species may reach abundant water supplies in the soil, there are various structural features by which the loss of water from the plant is compensated, such as the concealment of the stomata in furrows or under the revolute leaf margins or under hairs.

Arctic Fell-fields in Greenland and Iceland

Arctic fell-fields occur in Arctic North America, northern Europe, Siberia, Greenland, and Iceland. In different localities, according as the soil is more or less gravelly, clayey, or sandy, or warmer or colder owing to slope exposure, certain species occur sometimes in greater abundance and give stamp to the vegetation, so that it is possible to distinguish various associations of fell-field plants. Since Warming's work was published in English in 1909, a number of works have appeared which have thrown additional light upon the vegetation of fell-fields. Kruuse[4] describes the vegetation of the rocky-flat formation of eastern Greenland.

The Rocky-Flat Formation of Eastern Greenland

The rocky-flat formation of eastern Greenland comprises plants which are scattered to such a degree that the bare soil appears nearly everywhere. This formation may be found in all localities, flat as well as rugged, and with every kind of slope exposure. The snow cover is thin and open, the surface often being bare of snow throughout the winter. The soil is loose gravel or sand, often shifted by the arctic gales, so that erosion is sometimes great. Vegetable mold, or humus, is practically wanting. Water is never present in quantity. Kruuse divides the rocky-flat formation into (1) the common rocky-flat formation; (2) the gravel flats; (3) the gravel-sand slopes; (4) gravel hills; (5) sandy slopes. The latter subformation corresponds probably to our coastal dunes and should not be included as part of the fell-field formation.

The common rocky-field formation is found in eastern Greenland on wind-swept plateaus, hills, and declivities where rocks rise sufficiently above

[4] Chr. Kruuse: Rejser og Botaniske Undersögelser i Öst-Grönland mellem 65°30' og 67°20' i Aarene 1898-1902, samt Angmagsalik-Egnens Vegetation, *Meddelelser om Grönland*, Vol. 49, 1912, pp. 1-304.

the surface to keep the intervening loose soil in position. Such plants as *Empetrum nigrum, Silene acaulis, Ranunculus glacialis, Sedum Rhodiola, Diapensia lapponica, Vaccinium uliginosum* var. *microphyllum, Oxyria digyna, Salix herbacea, Lycopodium Selago* var. *appressa* are characteristic

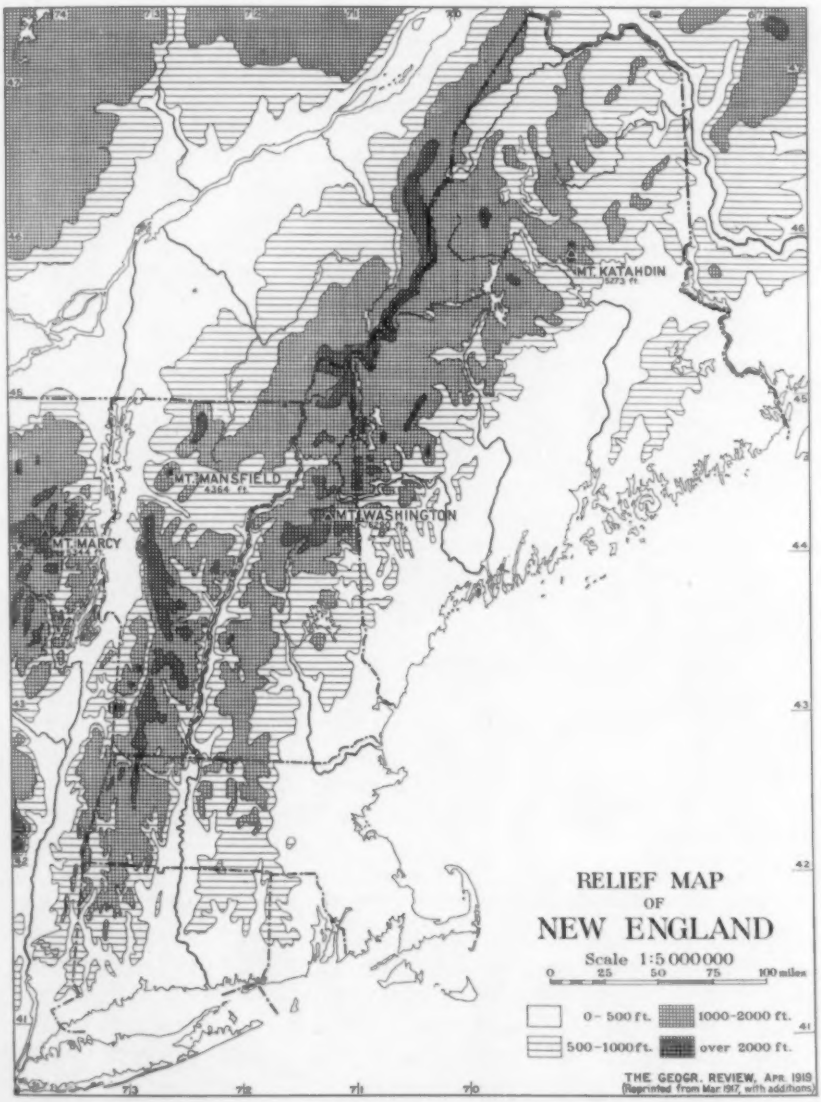

FIG. 1—Relief map of the New England region showing the location of the mountain summits bearing fell-fields discussed in the text. Scale, 1:5,000,000. (For sources used in drawing contours see the *Geogr. Rev.*, Vol. 3, 1917, p. 228, Fig. 1.)

on the Greenland *Fjaeldmark*. The gravel flats resemble the preceding but are destitute of rocks. They are replaced by coarse gravel, which is often disturbed and relaid by the winter gales. The surface is generally snowless. The flora is scanty, consisting mainly of ligneous plants, which are separated by wide intervals of soil space, frequently wind-torn and covered partially by gravel. The *Grusfladerne*, or gravel flats, are sometimes represented in

FIG. 2—Contour map of the Mt. Washington massif showing the location of the features mentioned in the text. Scale, 1:70,000. Contour interval, 20 feet. (Reproduced from the Mt. Washington and Crawford Notch, N. H., topographic sheets, 1:62,500, of the U. S. Geological Survey, 1896, with additional names.)

marine terraces with a sparse dwarf vegetation. The gravel slopes consist of coarse gravel heaped up into steep slopes by the wind or slid down from the sides of the adjacent mountains. The vegetation consists of *Silene acaulis, Salix glauca, S. herbacea*, and *Armeria sibirica*, which have long tap-roots (2-3 meters) by which they are rendered immovable, besides *Chamaenerium latifolium, Saxifraga oppositifolia* var. *reptans, Luzula confusa*, and *Cerastium alpinum*, which, not being anchored securely, frequently slide down the slopes with the moving gravel. The gravel hills

have a somewhat different vegetation owing to the greater stability of the surfaces, which are often broken by big rocks. *Azalea procumbens* is one of the plants of these gravel hills.

The Rocky-Flat Formation of Iceland

In Iceland, according to Th. Thoroddsen,[5] the rocky-flat formation occupies the largest area of the island. The vegetation of the rocky flat, which includes a great proportion of all the plant species of Iceland, may be divided according to soil conditions. On the higher plateaus, we find that the species and individuals become fewer in number and more scattered in growth (true fell-field), and these plants are usually stunted. On these elevated fell-fields mosses play an important part, especially *Grimmia hypnoides,* which gradually forms soil in which higher plants can grow. Fruticose lichens grow with the mosses, and "in many places on the plateau patches of *Anthelia nivalis* occur. The rocky-flat formation appears to be an original, late glacial formation . . . the different species having become associated according to their conditions of life. . . . As subdivisions, or nearly related formations, the following may be mentioned: gravelly flats (*melar*); stone-covered ridges (*holt*); fallen blocks and débris upon mountain slopes (*urd,* pl. *urdir*); steep cliffs (*hamrar*); gravelly river plains and river terraces (*eyrar*)," etc.

Gravelly flats (*melar*) also occupy large areas in the lowlands, the gravel being mixed with clay so that it cracks into polygonal cakes and forms a *rudemark.* These *rudemarker* greatly influence plant distribution, as the plants are generally confined to the gravel bands between the cakes, where they find shelter and protection. These gravel flats may be so poor in plant life that they appear quite bare and naked.

Fell-fields in South America and the European Alps

The *páramos* on the high mountains in South America from Ecuador to Venezuela are fell-fields with a typical open vegetation, the individuals scattered in clumps or of a cushion form, while the vegetation and its physiognomy on high African mountains are of similar character. On the *punas* in Chile we find that the arctic vegetation is composed largely of lichens and mosses scattered here and there over the surface. These are mountain steppes, the *punas* being poorer in species than the *páramos.*

The fell-fields are found in the Alps of Europe where both limestone and primitive rocks occur. The rubble, or talus, sets off the alpine plants which cling to the surface. In antarctic regions in South Georgia the plants form scattered cespitose tufts, as in *Poa caespitosa.* Dwarf shrubs occur and cushion plants, such as *Azorella caespitosa,* which is of a dirty-green color

[5] Th. Thoroddsen: An Account of the Physical Geography of Iceland, With Special Reference to the Plant Life (The Botany of Iceland, Rosenvinge and Warming, edits., Part I: 2), Copenhagen and London, 1914, pp. 325-326.

FIG. 3—Absolute tree line with low puckerbush and fell-field, western slope of Mt. Washington massif, August 23, 1918.

and more than a meter in height and is composed of little branches with scale leaves.[6]

The Fell-fields of the Higher Mountains of the Eastern United States

The preceding account will serve as an introduction to a study of the fell-fields of eastern North America which the writer has made in botanic exploration of the higher mountains of the eastern United States (see map, Fig. 1). It will enable the reader to appreciate the general principles upon which an investigation of the fell-fields on the summits of Mt. Katahdin in Maine (5,273 feet), Mt. Washington in the White Mountains of New Hampshire (6,290 feet), Mt. Marcy (or Mt. Tahawus, to use its Indian name) in the Adirondacks of New York (5,344 feet), and Mt. Mansfield in the Green Mountains of Vermont (4,364 feet) must be based. The areas on Mt. Marcy and Mt. Mansfield which represent fell-field are circumscribed.

The Fell-field on Mt. Marcy in the Adirondacks

On Mt. Marcy, according to the observations of the writer made on August 26, 1914, the fell-field occupies the immediate summit and roughly covers several acres of rocky ground. Here is a relatively flat surface covered with large angular blocks of crystalline rocks which have resisted the action of the elements for ages. The open summit, just below which is a rock ledge behind which the writer's party took shelter from the icy blast, may be compared to an ellipse whose axis lies in a northeast and southwest direction but whose circumference is irregular. The trail leading down directly to Keene Valley, some distance below the summit proper, passes over smooth-surfaced ledges where the crystalline core of the mountain outcrops or has been denuded of its surface covering of soil and loose boulders. Here the smooth outcropping rock has been split by deep narrow fissures. Nearer the top similar smaller outcrops occur, so that the areas actually occupied by plants are few in number and small in size. Where the smoother surfaces do not occur the loose boulders cover the summit fell-field area. These boulders are variegated by the different colors of the lichens growing on their hard and almost naked surfaces. The rocks beneath the lichens are more soft and scaly than elsewhere. Between and beneath the tufts of rock-growing mosses the interspaces are filled with dust and sand, apparently composed of particles of disintegrated rock. Between the boulders and in the rock pockets we find particles of disintegrated rock, soil, and sand mingled with the stems and leaves of the mosses and other

[6] Additional data bearing on the botany of fell-fields will be found in the following: C. H. Ostenfeld: The Land Vegetation of the Faeroes (Botany of the Faeroes, 1908), pp. 990-996 (Fjaeldmark); R. Speight, L. Cockayne, and R. M. Laing: The Mount Arrowsmith District: A Study in Physiography and Plant Ecology, *Trans. and Proc. New Zealand Inst.*, Vol. 43, 1911, pp. 315-378 (see especially pp. 359-360); J. W. Bews: An Account of the Chief Types of Vegetation in South Africa, With Notes on the Plant Succession, *Journ. of Ecology*, Vol. 4, 1916, pp. 129-159 (see especially p. 135).

alpine plants, so that there is provided sufficient soil to permit the growth of the few low shrubs, prostrate balsams, and other characteristic species which grow on the summit. The boulders serve to protect the growing plants from the dry winds and icy blasts which blow across the mountain dome. The soil in most places is but a few inches deep, but as the rock crannies are filled with it and with loose rock fragments, the roots of the alpine plants can descend to considerable depths without opposition to their growth.

Its Characteristic Plants

On this circumscribed alpine fell-field of Mt. Marcy grow several interesting lichens. The soil-inhabiting ones are *Thamnolia vermicularis* (Fig. 4) with its white, frequently curled, quill-like thalli. The rounded cushions

Fig. 4—The worm lichen (*contrayerba blanca*), *Thamnolia vermicularis*, growing out of a carpet of mosses found on rock ledges, head wall of Great Gulf, Mt. Washington, August 23, 1918.

of the reindeer lichen, *Cladonia rangiferina*, are found; as is also Iceland moss, *Cetraria islandica*. The alpine club moss, *Lycopodium Selago*, is a fell-field plant; as also are such flowering plants as *Arenaria groenlandica*, *Potentilla tridentata*, *Cornus canadensis*, *Vaccinium pennsylvanicum* var. *angustifolium*, *Nabalus Boottii*, and *Ledum groenlandicum*. In the lee of rock ledges *Diapensia lapponica* was found growing in its characteristic cushion form. *Salix uva-ursi* is a dwarf prostrate willow. The alpine rattlebox, *Rhinanthus crista-galli*, was found in flower at the summit, along with other plants which live protected in the soil pockets on rock ledges or in the crannies and crevices of the rough angular boulders or slabs of crystalline rock which lie in confusion on the dome-shaped top. Photographs of Mt. Whiteface (4,872 feet), 16 miles north of Mt. Marcy, show

similar conditions of fell-field, while Giant Mountain (4,622 feet) is not bare at the summit except where shelving rocks occur.[7]

The Fell-field on Mt. Mansfield in the Green Mountains

Fell-field may be said barely to exist on the summit of Mt. Mansfield except for the *arête*, or sharp ridge connecting the top (Chin) with the lower forest-covered parts (Nose) of the Mansfield massif.

The Fell-field on Mt. Katahdin

The top of Mt. Katahdin is an extensive plateau covered with tabular blocks or slabs of red granite, which increase in size upwards toward the West Peak, the highest point. The red granite on weathering splits into blocks more or less regular in form which strongly resemble courses of crumbling masonry. So friable is this rock that it crumbles readily, giving rise to a residual granitic soil which fills the rock crevices, rock pockets, and rock crannies as the original soil of the mountain. The slopes south from the two chief peaks are covered with loose, angular fragments as far down as the (so-called) tree line. The wind-swept balsam trees grow in the clefts between the confused, loosely piled blocks. Frost action has split these rocks into every conceivable form. The rocks of this fell-field formation are covered with the crustaceous lichen *Lecidea geographica*, whose thallus, alternately black and yellow, resembling a colored map, gives them a yellowish-green tone. Other crustaceous lichens begin as small patches and expand into mats and carpets which cover the boulders. *Tripe-de-roche, Umbilicaria* sp., as a rock lichen, accompanies the preceding form, as also several lithophytic mosses, such as *Andreaea petrophila, Rhachomitrium sudeticum*, and *R. aciculare*. The detritus produced by the wash, decay, and disintegration of the rocks, along with the organic remains of lichens and mosses, prepares a soil suitable for the reindeer lichen, *Cladonia rangiferina*, and Iceland moss, *Cetraria islandica*.

Accompanying the growth of these lichens, more material is accumulated to form a soil sufficient for the plants which characterize the alpine tundra. Here are such grasses, according to Harvey, as *Hierochloë alpina, Agrostis rubra, Deschampsia flexuosa;* such sedges as *Carex vulgaris hyperborea* and rushes as *Juncus trifidus*, accompanied by mosses such as *Mielichhoferia nitida elongata, Polytrichum commune, P. juniperinum* and *P. ohioensis*. In the ecologic succession of plants on this alpine fell-field, *Lycopodium annotinum* var. *pungens, L. Selago, Arenaria groenlandica*, and *Potentilla tridentata* appear or live side by side with the lichens and mosses above mentioned.[8] This is explained by different summit areas being in a more advanced or more retrograde stage of physiographic and edaphic

[7] J. W. Harshberger: The Plant Formations of the Adirondack Mountains, *Torreya*, Vol. 5, 1905, pp. 187-194; *idem:* Phytogeographic Survey of North America (Die Vegetation der Erde, Vol. 13), Leipzig and New York, 1911, pp. 405-408.

[8] J. W. Harshberger: A Botanical Ascent of Mt. Katahdin, Maine, *The Plant World*, Vol. 5, 1902, pp. 12-28. The ascent was made by the writer on August 1, 1900.

development. Later the low heaths appear, some growing normally only when sheltered by some projecting slab of granite. The pioneer heaths are *Vaccinium pennsylvanicum* var. *angustifolium*, V. *uliginosum*, *V. Vitis-Idaea*, and the cushioned *Diapensia lapponica*. Of less frequency are *Ledum latifolium*, *Arctostaphylos alpina*, *Rhododendron lapponicum*, *Cassiope hypnoides*, *Loiseleuria procumbens*, and *Phyllodoce caerulea* (*Bryanthus taxifolius*).

The conditions on this table-land are very severe, and some of the plants mentioned only succeed by growing in the shelter of the granite blocks or by sending their roots down to considerable depths in the rock crannies. *Arenaria groenlandica*, with its multitude of rootlets and its branching habit, can do this, as well as *Rhododendron lapponicum;* while *Arctostaphylos alpina*, *Vaccinium uliginosum*, etc., grow in spreading mats.[9] Even on the summit fell-field the alpine mats are encroached upon by dwarf prostrate trees such as *Betula glandulosa* and *B. papyrifera minor*, which, gradually increasing in number as the slopes are reached, merge with the dwarf timber at the tree line, viz. the puckerbush, or *krummholz*. The scattered condition of the alpine fell-field plants is emphasized in the tufted growth of several grasses, sedges, and rushes like *Juncus trifidus* and *Scirpus caespitosus*. A number of other species are characteristic of this alpine garden, where, as the moisture content of the soil increases because of the presence of a spring or where the snow remains well into the summer months, the fell-field conditions pass over into the alpine meadow societies.[10]

Two kinds of granite are found on Mt. Katahdin, the red kind, previously mentioned, and a gray kind, composing the lower two-thirds of the basin walls. These two granites are probably ultimately of the same character. The brownish-red granite, which concerns us in this paper, has been studied by Dr. M. E. Wadsworth.[11] He notes that the feldspars are colored pink and greenish white and that the calcite and a greenish talcose mineral occur as alteration products. In their section the feldspar is seen to be altered greatly and the biotite is partly decomposed. The structure of this red granite, which covers the upper 700 feet of the mountain, has determined the character of the summit and the form of the upper slopes and therefore, directly, the distribution of the trees and the other plant life of the summit.

Fell-fields of the Mt. Washington Massif

The Region Investigated

The fell-field of the alpine portion of the Mt. Washington massif is the particular theme of this paper. Three days were spent by the writer on

[9] No attempt is made in this account of fell-fields to enumerate all of the plants found on the mountains described. Only a few representative species are mentioned.

[10] L. H. Harvey: A Study of the Physiographic Ecology of Mt. Ktaadn, Maine, *University of Maine Studies No. 5*, Dec., 1903.

[11] C. E. Hamlin: Observations upon the Physical Geography and Geology of Mt. Ktaadn and the Adjacent District, *Bull. Museum Comp. Zoöl.*, Vol. 7, Cambridge, Mass., 1881, pp. 189-223; reference on p. 209.

the top of Mt. Washington—July 18-20, 1903—in the investigation of its alpine flora. The survey included the summit, the slopes, the Alpine Garden, and the head walls of the Great Gulf and Tuckerman Ravine (for locations, see map, Fig. 2). It enabled the writer to become familiar with the general topography, geology, and vegetation of the mountain, and the fact that the Alpine Garden represented a fell-field was impressed upon him. A number of articles setting forth his impressions appeared in *Among the Clouds*, a paper printed on the top of the mountain.[12] A second

FIG. 5—Prostrate balsam trees (*Abies balsamea*) on the upper slopes of the Alpine Garden, Mt. Washington, August 23, 1918. To the left is a tussock growth of *Scirpus caespitosus*.

visit to Mt. Washington with the specific object of photographing and studying the fell-fields was made on foot from Bretton Woods, and two days—August 23-24, 1918—were passed in a study of the vegetation of the head walls of the Great Gulf and Tuckerman Ravine, the Alpine Garden, and the fell-fields elsewhere on the summit and about the Lakes of the Clouds.

NATURE OF THE DOME

The summit and slopes of the dome of the Mt. Washington massif are a jumble of large slabs and boulders of granite. On the shoulders near the summit, as at the head of the Great Gulf, the coarse alpine sedges and grasses form an almost continuous sward, broken only by flat granite blocks which hardly rise above the grassy surface. Here alpine grass-

[12] "Our Mountain Flora," July 18, 1903; "The Great Gulf," July 23, 1903; "The Individuality of Mountains," Sept. 8, 1904.

meadow conditions are simulated; but the flora of these areas—an unusual condition on alpine summits—is a scanty one. Elsewhere on the alpine flanks of the dome the rocks are piled up in the greatest confusion, many of them covered with lichens and mosses. They are hoary with age and exposure to the severe meteorologic conditions. Pockets of earth are found of greater or lesser size, and great rifts in the rocks are almost cavernous in their extent. The drainage of such soils must be nearly perfect, as is evidenced by the successful growth of many alpine species which do not flourish in an ill-drained soil.

Water Supply of Alpine Plants

The rocky surface, however, serves as a protective check against too rapid loss of water from the soil, so that by growing down deeply the roots of most alpine plants are able to get the necessary water supply, as the plants have various structural or anatomic details by which the loss of the absorbed water is more or less completely regulated. It has been the experience of gardeners that numbers of alpine plants perish if planted in the ordinary soil of our gardens. But many of these rock plants, if so placed that their roots are in a dry spot, remain in perfect health. Many plants from mountains a little farther south and from alpine regions find on walls congenial conditions for healthy growth. A wall properly constructed for the growth of alpines ensures comparative dryness in winter and assures against drought in summer. This apparent paradox is easily explained, for the heavy rains and snow water of winter will pass through a mass of broken stone more readily than through a similar body of soil, and in summer the stones of the wall prevent loss of water by evaporation. Such a wall, therefore, drains away superfluous water but conserves the precious minimum supplies upon which alpine plants depend. Probably everyone has noticed, on removing a large stone, that the soil beneath it is moist while the surrounding soil not similarly covered is dry. So beneficial to the roots is contact with the cool stones that plants which would perish from drought in the lighter soils remain fresh and green in a rock wall under the hottest exposure, since there is moisture deep in the crevices. In the fall of the year the rock plants become thoroughly "ripened" and their tissues hardened by exposure to the heat of the sun and stones in contact with their roots, stems, and leaves.

Extremes of Temperature on Mountain Summits

Similarly the alpine fell-field is exposed to intense illumination, and the soil heats up rapidly in the daytime; but after sundown it parts with the heat with equal rapidity, so that on a clear evening it becomes intensely cold. A similar difference is noticeable between the sunny and the shady places on high mountains, as the writer experienced on the Gorner Grat (10,290 feet) some years ago while botanizing in the Swiss Alps. Here at

noonday the soil and stones on the north side of the shelter hut were frozen hard, while on the south side the soil had thawed to the depth of one or two inches, so that the larger stones could easily be removed.

Aspect and Soil

Aspect, or exposure, which may be defined as the point of the compass which any sloping land faces, is of great importance in the distribution of alpine plants. This is true especially on Mt. Washington, for the head wall of the Great Gulf with its northern aspect supports a greater variety of alpine plants than the top of Mt. Washington itself. A minor feature of

Fig. 6—Fell-field of the Alpine Garden, Mt. Washington, August 23, 1918. Note round cushions of *Diapensia lapponica* in the foreground.

this exposure is seen on the flatter slopes of the fell-field proper, where the level is broken by the rocks, which provide different aspects and drier or moister positions. These rocks vary from true rock ledges through blocks, boulders, slabs, loose angular pieces, cobblestones, pebbles, etc., to coarse gravel and sand, which, sorted by glacial action, winds, snow, and rains, provide the edaphic environment of the hardy alpine plants. These comprise earth-inhabiting or rock-inhabiting lichens and mosses (lithophytes) and the soil-growing flowering plants which are able to grow because of their various root adaptations and because such plants have regulatory aërial structures to control transpiration and to adjust themselves to other influences of an alpine climate. Schröter[13] divides the plants of the fell-fields, as to their habits of growth with reference to the soil, into (1) earth-inhabiting plants (lichens, mosses, and seed plants); (2) shingle-inhabiting (seed) plants; and (3) rock-inhabiting plants (lithophytes), which include

[13] C. Schröter: Das Pflanzenleben der Alpen, 1908, p. 514.

surface-growing mosses and seed plants, crevice plants, rock-penetrating plants (lichens and mosses), and rock-attached plants (algae). The lichens and mosses have rhizoids, while the seed plants have true roots. The earth-inhabiting plants (chomophytes) may grow in clay, loam, sand, or fine gravel soils, etc. Oettli calls[14] the rock-surface plants exochomophytes to distinguish them from the preceding alpine plants and from those which accommodate their growth to the rocky clefts and fissures of the fell-field surface (chasmophytes).

Vegetation of the Mountain Shoulder near Jacob's Ladder

Having considered the general conditions of soil and aspect of the alpine fell-fields of Mt. Washington, it is next important to treat of the specific details which were investigated during the summer of 1918. Jacob's Ladder, on the mountain railroad, has long been celebrated for its trestle spanning one of the steepest grades of the ascent. Off from the trestle there is a relatively flat place formed by a projecting shoulder of the mountain. Large slabs of granite are piled up in a cairnlike ridge, and behind this pile of rocks low, spreading, wind-swept balsam trees, *Abies balsamea,* are found, the tops of the trees just reaching to the crest of the lichen-covered rocks (Fig. 3). Here the Labrador tea, *Ledum groenlandicum,* forms extensive masses of low shrubbery, as likewise do the low and spreading bushes of the bog bilberry, *Vaccinium uliginosum,* and the still more dwarfish low, sweet blueberry, *Vaccinium pennsylvanicum* var. *angustifolium,* together with the low creeping stems of the mountain cranberry, *Vaccinium Vitis-Idaea,* with its erect branches and dark red berries in late summer shining between the dark, evergreen leaves. The roots of these three plants are specialized in the possession of endotrophic mycorrhiza, which, some botanists have suggested, absorb the nitrogen of the air and assimilate it. The crowberry, *Empetrum nigrum,* is a many-branched undershrub seldom over two feet tall and with many earth-creeping stems covered with numerous short, awl-shaped leaves of the ericoid type. It forms dense, dark green, cushion-like growths. Tufts of *Lycopodium annotinum* var. *pungens* are scattered between the rocks on the level places, together with the rounded pincushion-like plants of *Diapensia lapponica.* The three-toothed cinquefoil, *Potentilla tridentata,* the bunchberry, *Cornus canadensis,* and the creeping snowberry, *Chiogenes hispidula,* sending out long, running shoots over the bare ground or over the moss-covered rocks, contribute their growth to the Japanese garden effect of the vegetation of this mountain shoulder. One other plant growing out of the moss cushions is a noteworthy cosmopolitan lichen, *Thamnolia vermicularis* (the worm lichen), found also by the writer in moss carpets of the head wall of the Great Gulf (Fig. 4). The chalk-white, cylindrical, twisted podetia of this lichen suggest the name applied to it by the mountaineers of the Peruvian Andes, *contrayerba blanca.*

[14] M. Oettli: Beiträge zur Ökologie der Felsflora (Zurich Polytechnic Institute thesis), Zurich, 1905.

Castilleja pallida var. *septentrionalis*, the white painted cup, is a perennial growing out of the rock crevices. The true alpine club moss, *Lycopodium Selago*, also occurs here.

Vegetation of the Alpine Garden

Climbing down the treacherous rocks below the hotel on the top of the mountain to the plateau known as the Alpine Garden, about a thousand feet below, abundant masses of the Labrador tea, *Ledum groenlandicum*,

Fig. 7—The summit dome of Mt. Washington seen across Tuckerman Ravine. The intervening platform is the Alpine Garden, terminating in Lion Head in the right foreground. Notice the flat shelf on the left connecting the Garden with the shoulder between Mt. Washington and Mt. Monroe.

were found filling up the flatter depressions between the blocks of granite, which appear as if they had slipped down the mountain side. *Phyllodoce caerulea (Bryanthus taxifolius)* is a low, alpine, heathlike undershrub, which is more abundant on these mountain slopes between the granite boulders than on the declivities of the Great Gulf, where it was collected by the writer in 1903. Here also the interspaces of the rocks were occupied by the low shrubs of the bog bilberry, *Vaccinium uliginosum*, with its twisted stems prostrate between the rough boulders. Occasionally on the descent patches of meadow sweet, *Spiraea latifolia*, in full flower were passed, contributing their quota to the rock-garden effect. The upper slopes of the Alpine Garden are covered with dense tangled thickets of balsam trees, *Abies balsamea*, which form the puckerbush, dwarf timber, or *krumm-*

FIG. 8—Typical fell-field in the saddle between Mt. Washington and Mt. Monroe, looking toward Boott Spur (about 5,500 feet), August 23, 1918. Note the coarse grasses and other alpine plants between the slabs of granite.

holz (Fig. 5) through which the writer forced his way or over the tops of whose interlaced branches he walked without slumping through. Balsam trees at the elevation of the Alpine Garden (5,500 feet) rarely produce seed. Reproduction depends not only on seeds blown up from below but mainly on the layering of the trees. The roots always develop from the prostrate branches, and the branches so layered often develop as independent trees by the decay of the connecting branch. Cones are born sparingly at 4,900 feet, and even here reproduction by layering exists. The scrub forms of balsams extend down to 4,500 feet, while the trees of merchantable size begin to appear at 4,000 feet. On the alpine stretches of the Presidential Range the dwarf trees are very shallow-rooted, needing only a mossy bed for the seeds to germinate. The balsam can grow almost on bare rocks, if it starts its growth in a mossy cushion covering the rock. There are some bare areas here where the balsams do not grow (Fig. 5), and these are characterized by cushions of the alpine willow, *Salix herbacea*, and tussocks of the dense, stiff, erect wirelike stems of the sedge *Scirpus caespitosus*.

Along Six Husbands Trail, which crosses the flatter portions of the Alpine Garden plateau (Figs. 6 and 7), we find the fell-field vegetation to consist of numerous low cushions of *Diapensia lapponica*, the basketlike growths of *Phyllodoce caerulea*, and the isolated clumps of the white painted cup, *Castilleja pallida* var. *septentrionalis*, one of the few plants in flower late in August, 1918. Here also are tufts of bitter cress, *Cardamine bellidifolia* var. *laxa*, in fruit. The reindeer lichen, *Cladonia rangiferina*, reminded one of its cosmopolitan distribution in the high North, where it forms one of the important foods of the Lapland reindeer. The roundheaded clumps of *Rhododendron lapponicum* relieve the rocky surface. Near the end of Six Husbands Trail the source of the stream which descends through Tuckerman Ravine is found in wet places, fed by springs which emerge from the loosely piled rocks of the massif above. Here are numerous plants of the green hellebore, *Veratrum viride*, growing out of a sphagnum carpet, while the cold spring water is characterized by masses of some bright-green filamentous alga.

Conditions of Saddle between Mt. Washington and Mt. Monroe

The depression of the Presidential Range between Mt. Washington and Mt. Monroe flattens out into a plateau, or fell-field (Fig. 8), which is the source of two important streams rising in springs which gush from the loosely piled blocks of granite. The source of the Tuckerman Ravine affluent of the Cutler River (Fig. 7), feeding Hermit Lake in the bottom of the ravine, has been noticed as being on the east side of the range. On the western side the volume of the springs is sufficient to supply two mountain tarns, known as the Lakes of the Clouds, the outlet of which is the source of the Ammonoosuc River. Near this outlet stands the new Appalachian

Mountain Club Hut, formally opened on August 7, 1915. This plateau holds the Lakes of the Clouds, and the mirrorlike surfaces of their waters reflect the rocky shores and the mountains in the background. The plateau is really a continuation of the Alpine Garden, which terminates in the Lion Head above Tuckerman Ravine (Fig. 7). Northeastward the Alpine Garden is bounded by Huntington Ravine. The elevation of this plateau is between 5,000 and 5,500 feet, for its surface is undulating in its extent from Huntington Ravine around the head of Tuckerman Ravine to Boott Spur and the eastern slopes of Mt. Monroe. Here, as along the upper slopes of the Alpine Garden, the dwarf timber, or puckerbush, pushes up the moun-

FIG. 9—Rounded shrub of Lapland rosebay (*Rhododendron lapponicum*) in flower on fell-field, Mt. Madison, N. H. (at 5,000 feet), June 25, 1917. (Photo by Ralph E. Cleland.)

tain in favorable protected places so that, as the photographs show (Figs. 3 and 5), the absolute timber line, represented by the extension upward of the dwarf prostrate balsam, *Abies balsamea*, is not many hundred feet below the top of Mt. Washington. Descending from the hotel on the summit of the mountain, just before the more level Alpine Garden was reached, the writer had to force his way through the dwarf timber. In some cases he walked some distance on the tops of the prostrate trees, in accomplishing which feat he recalled Thoreau's account of a similar trip up Mt. Katahdin.[15]

As one looked along the saddle towards Boott Spur and Mt. Monroe the spaces between the rocks were seen to be occupied by rushes, sedges, and grasses (Fig. 8). Several species of the genera *Carex*, *Juncus*, and *Scirpus* were noted, either in isolated cushions (tussocks) or covering an ex-

[15] H. D. Thoreau: The Maine Woods, Boston, 1864, p. 61.

tended soil surface and giving rise to a dry alpine meadow.[16] On Mt. Washington *Scirpus caespitosus* is one of the most important of the tussock sedges. Few alpine plants grow amongst the tough, wiry, grasslike plants. Off from the grassy stretches were found masses of *Salix herbacea*, as well as the rounded cushions of *Arenaria groenlandica* and *Rhododendron lapponicum* (Fig. 9) in full flower on August 23, 1918. Here, as the western slopes of the saddle were approached, were found isolated clumps of balsam trees spread over the rocky fell-field.

Bryophytes form, as in Iceland, a prominent part of the vegetation of this rocky flat. The dry flat is often poor in plants and occasionally devoid of vegetation. The mosses occur in scattered cushions, especially around somewhat large stones, where they can hold fast and find some shelter. In somewhat damper and less exposed areas moss heaths are developed, as on the lava fields of Iceland. On somewhat damper ground, especially where large blocks lie scattered and afford shelter, the mosses become richer and form a continuous carpet. As on the slopes of the head wall of the Great Gulf, there are places on this saddle where the creeping stems of *Salix herbacea* are interwoven in a dense moss carpet, so that only the tips of the moss shoots project above the carpet. Helgi Jónsson has called attention to somewhat similar conditions on the rocky flats of Iceland.[17] On dry stony tracts there often occurs a continuous, though circumscribed, growth of mosses. Here the higher plants grow scattered without giving character to the vegetation. These areas, as in Iceland where they are more extensive, may be called moss heath patches. By the decay of the mosses a humus layer is gradually formed.

Fell-field about the Lakes of the Clouds

The fell-field about the Lakes of the Clouds is characterized by a richer alpine flora than elsewhere; and, because of the larger amounts of permanent soil water, not only does the number of individuals of any one species increase, but also the number of species is augmented considerably. The shores of the two alpine tarns are rocky, with scattered blocks and slabs of granite, and at several places the rocks are shelving and precipitous (Figs. 10 and 11). The clear cold water of the lakelets, derived from springs beneath the rocks, does not support the usual aquatic plants. Similarly, the high alpine lakes of the Swiss Alps are devoid of flowering plants. In his enumeration of the vegetation of the lakes of the region of the Bernina Pass, Rübel[18] does not mention any of the higher plants but only diatoms, blue and green algae, which can perform their functions in the icy waters of these alpine tarns. The shores of the Mt. Washington

[16] J. W. Harshberger: Phytogeographic Survey of North America (Die Vegetation der Erde, Vol. 13), Leipzig and New York, 1911, p. 377.

[17] The Botany of Iceland (Rosenvinge and Warming, edits.), Part II, Copenhagen and London, p. 591.

[18] E. Rübel: Pflanzengeographische Monographie des Berninagebietes, *Botan. Jahrbuch*, Vol. 47, 1912, pp. 1-616.

lakelets, where the presence of large boulders does not prevent, are bordered by cushioned mosses and low, overhanging, prostrate shrubs and trees.

The flat places along the east shore of the upper lake are covered with cushions of mosses, some of a light-green color (Fig. 10). Rooting through these mosses, which are associated with light gray patches of the reindeer lichen, *Cladonia rangiferina*, we find the bog bilberry, *Vaccinium uliginosum*, in low, spreading bushes, and the crowberry, *Empetrum nigrum*, mixing its growth with that of the low, narrow-leaved blueberry, *Vaccinium pennsylvanicum* var. *angustifolium*, while out of the sphagnum, which in some places forms the boggy shore line, grows the yellow mountain avens, *Geum* (*Sieversia*) *Peckii*, with its flowers bending over the water's edge (Fig. 11). Sprawling over the flatter boulders, beside which its roots extend into the rock crevices, we find the graceful dwarf birch, *Betula glandulosa*, which ranges north to the Arctic regions, and nearby the Labrador tea, *Ledum groenlandicum*, forming low dwarf clumps of spreading bushes. *Lycopodium annotinum* is found here, and the green hellebore, *Veratrum viride*, forms societies in damp, boggy places with its light-green foliage outlined against the dark-green mosses of the prostrate, wind-swept balsam trees and protected from the wind by some large projecting mass of rock (Fig. 11).

FIG. 10—Upper tarn, Lakes of the Clouds, Mt. Washington, August 24, 1918. The low shrubs on the slopes of the fell-field above the lake are seen in the background. The outlet is in the foreground.

Cushions of hair mosses, *Polytrichum*, vary the colors of the fell-field vegetation along the shores of the upper lake, as do meadow-sweet, *Spiraea latifolia*, bunchberry, *Cornus canadensis*, and mayflower, *Maianthemum canadense*. The outlet of this tarn (Fig. 10) is by a channel which leads to the edge of the head wall of the Ammonoosuc Ravine. In late summer this outlet is dry, but the rounded cushions of hair mosses, separated from each other by narrow or wide spaces, indicate the direction of the overflow channels in wet weather. The west shore of the upper lake is more pre-

FIG. 11—Lower tarn with prostrate balsam trees fronted by moss cushions of the moss bog and the loose rocks of the lake shore, Lakes of the Clouds, Mt. Washington, August 24, 1918.

cipitous, the strongly fissured ledges rising vertically from the water. Among the rock mosses grow twisted balsams, *Abies balsamea*, spreading outward over the flatter places. A few of these dwarf trees have twisted trunks as large as a man's leg. The less rocky slopes are covered with low bushes of the Labrador tea, *Ledum groenlandicum*, and bog bilberry, *Vaccinium uliginosum*, while on the flat, bare soil spaces hereabout are cushions of *Diapensia lapponica*, reindeer lichen, *Cladonia rangiferina*, spreading growths of mountain cranberry, *Vaccinium Vitis-Idaea*, with red fruit. Spreading masses of crowberry, *Empetrum nigrum*, also contribute their quota to the vegetable covering of the fell-field, where the boulders support various rock-growing lichens, such as *tripe-de-roche*, *Umbilicaria*. The rifts or depressions between two of the large boulders

are characterized by the bunchberry, *Cornus canadensis, Clintonia borealis, Vaccinium pennsylvanicum, V. Vitis-Idaea,* and *Potentilla tridentata.* An especially deep rift protected the dwarf mountain birch, *Betula pumila,* which scarcely reached to the top of the boulders between which it grew.

The slopes of the fell-field around the lower lake are less steep. In late August a stream of crystal water issued forth among the rocks as its outlet. Over this outlet stream spread the branches of dwarf balsams, dwarf birches, *Betula glandulosa,* dwarf willows with dark-green, lustrous foliage, *Salix phylicifolia.* Bog bilberry, *Vaccinium uliginosum,* hangs over the stream of water as it gurgles among the rocks and among mossy cushions of *Polytrichum* and *Sphagnum,* out of which grows the yellow mountain avens, *Geum Peckii.* Here are also tufted growths of *Arenaria groenlandica* (Fig. 12) among the rocks, and the photograph shows how the rocks are arranged in forming the surface of the alpine fell-fields hereabout. *Salix argyrocarpa* also fringes the outlet stream as a low, spreading shrub, and nearby is *Salix uva-ursi.* The shore line consists of soft beds of *Polytrichum, Sphagnum,* and other alpine mosses. Out of them grow bluets, *Houstonia caerulea* var. *Faxonorum,* gold thread, *Coptis trifolia, Viola palustris,* with round cordate to reniform leaves and pale lilac flowers, and the yellow avens, *Geum Peckii.* Other flowering plants occur in season.

Alpine Moss Bogs

Near where the principal spring which feeds the lower tarn issues forth, and in places around its shore, we find repeated on a small scale the moss bogs of Iceland (Icelandic, *dý*) described by Helgi Jónsson.[19] In Iceland they are bright-green moss carpets around and below the place of issuance of a spring, and they form one of the most frequent and characteristic plant communities of arctic and subarctic regions. Grönlund (1877) was perhaps the first ecologist to call attention[20] to the mats of green mosses along small streams on mountain sides. Moss bogs, which have their counterpart on a small scale around the Lakes of the Clouds on Mt. Washington, develop in Iceland on muddy soil in all places where water emerges as a spring. They occur on mountain slopes, at the bottom of valleys, and also at higher levels on rocky flats. There the mosses grow scattered in bright-green patches differing greatly in size and conspicuous even at a distance by their color, which is distinct from that of the deeper greens of the surrounding plants. These mosses on Mt. Washington, as in Iceland, are subjected to the influence of cold, well-aërated water, which determines the character of the plant associations. During the summer the low temperature of the water, also influenced by evaporation from the moss surface, acts as a check to the growth of the higher plants and is,

[19] Work cited in footnote 17.

[20] Chr. Grönlund: Islandske Naturforhold, *Tidsskr. for populaere Fremst. af Naturvidensk.*, 5 R, Vol. 4, 1877, pp. 321-356.

therefore, indirectly favorable to the moss vegetation. The distribution of mosses and the higher plants is also due to the character of the substratum —whether gravelly or muddy.

Conclusion

In conclusion the writer believes that comparative ecologic studies, such as this, are important for the classification of our knowledge concerning the fundamental units of vegetation the world over. We have reached a

FIG. 12—*Arenaria groenlandica* as a cushion plant in flower growing out from the crevices of the loose rocks of the fell-field near the outlet of the lower Lake of the Clouds, August 24, 1918.

stage in our investigations where it is profitable to compare American plant formations with those of Europe and other parts of the world. The writer has attempted to make this correlation with reference to the fell-field formation, and in another place he has made a comparative study of American and European heaths and pine heaths.[21] Few papers have hitherto appeared in which such comparisons have been made. This field of research is one that promises substantial progress in our elucidation of the problems confronting us in a study of American units of vegetation. The three international phytogeographic excursions have done much to stimulate this kind of comparative investigation, and those which will follow will undoubtedly stimulate the same kind of inquiry.

[21] J. W. Harshberger: American Heaths and Pine Heaths, *Brooklyn Botanic Garden Memoirs*, Vol. 1, June 6, 1918, pp. 175-186.

AIR ROUTES TO AUSTRALIA

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Lord Montagu, the authority on aëronautics, in a recent lecture on world air routes has said:[1]

> It is clear that meteorology and the study of wind currents is going to be of supreme importance. The knowledge of the world's atmospheric conditions and accurate forecasts, apart from their inherent scientific interest, may effect the saving or spending of millions of money annually, when postal and commercial aviation is established.

The advent of steam has decreased the economic importance of surface winds and currents, but the sailing ships in the Australian trade are still bound by weather laws and have only one route. They come from Africa to Australia, but return to Europe via Cape Horn. The reverse route, though possible, involves permanent head winds and unfavorable currents which remove it from the regions of economic trade. Much more will the air routes depend on the variations of weather and climate.

Upper Air Studies in the Past

The study of surface winds and of the general circulation of the atmosphere dates back to very early times, but it was first put on a firm basis in 1856 by Ferrel's and Maury's treatises. The first experimental investigations of upper currents, apart from the study of clouds, volcanic banners, etc., were made about 1890, and a little later the Hargrave box kite (invented in Australia) was used profitably in America for this purpose.

It is only in the last twenty years, however, that the exploration of the upper air has been carried out at all generally, but now research is world-wide. For instance, in 1911 Simpson first sent up sounding balloons in Antarctica (where the writer was initiated), and in 1913 and 1914 the upper air of Australia was investigated in the same way at Melbourne. The conditions over the northern regions of Australia are almost unknown, and we depend on Java for any knowledge that is available.

Like so many scientific experiments their immediate practical value was not obvious to the man in the street. Now that aviation, however, has come into its own, these explorations of the upper air have already proved of value. The United States government has devoted $100,000 to meteorological research connected with military aviation; and it is to be hoped that the military and political authorities of Australia will in the future show more interest in the matter than they have shown hitherto.

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[1] Lord Montagu: The World's Air Routes and Their Regulation (Paper Read Before the Aeronautical Society, June 21, 1917), *Flight*, No. 444, Vol. 9, 1917, pp. 653-659, London.

The Most Feasible Route to Australia

Let us now see which are the most promising routes to this isolated continent. The writer has given the matter considerable attention in his lectures at the Commonwealth Aviation School. In Figure 1 is given a somewhat unusual world map (on Sylvanus' projection) where the position of Australia with regard to the other continents is well brought out. Though the edges of the map are necessarily distorted, it shows us that Australia is situated in the center of the largest expanse of water in the

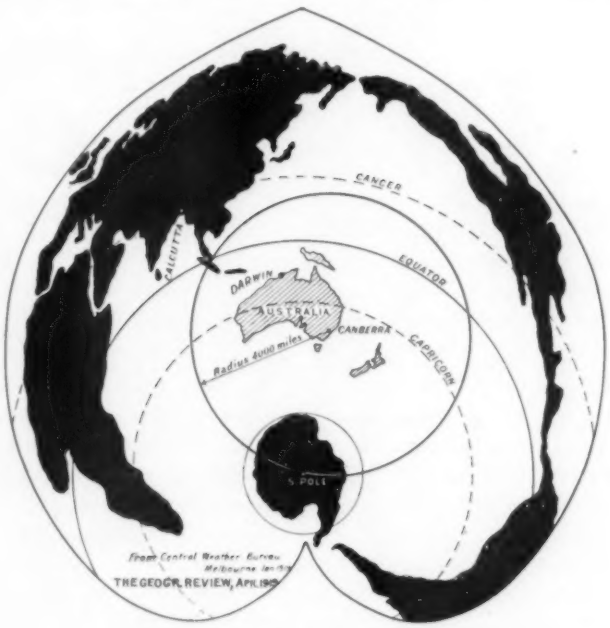

FIG. 1—World map on Sylvanus' projection showing the isolation of Australia. Scale, 1:292,500,000.

world, which we may term the Pacifico-Indian Ocean. This sheet of water is itself surrounded on all sides by land except to the south of Africa (for Antarctica entirely shuts off the waters to the south of Australia) and will for long prove an obstacle to flights from most of the continents.

If we draw a circle of 4,000 miles radius from Canberra (which is happily placed almost at the center of population of Australia), we find that it passes directly through Antarctica (near the South Pole) but includes none of the other large land masses. The nearest continent is therefore of little use as a flying station. Africa and the Americas are ruled out by distance; they are separated from Australia by 7,000 miles of water with but few islands in most directions. There remains, therefore, Asia; and it is by way of India and the Straits Settlements that the

first airplane services may be expected to travel. We have all read of the recent flights from England to India; they were accomplished with comparative ease in about four days. Such flights will soon become almost weekly occurrences.

Stations between Calcutta and Canberra

Nature has placed stepping-stones from India to Australia in the form of the drowned volcanic ranges, which are, of course, the islands of Sumatra, Java, and Timor; and these lead directly to Port Darwin, the chief settlement on the northern coast of Australia. I have drawn up a list of stations for an air route from Calcutta to Canberra with their distances. At all of these, except perhaps Koepang and Mataranka, there are, I believe, stores of petrol and facilities for repair (see Fig. 2).

As regards the time occupied, Lord Montagu in his paper on world air routes assumes about 1,200 miles a day as the average passenger-plane speed. Mr. G. Holt Thomas in a recent lecture before the Aeronautical Society of Great Britain[2] showed a map of the world crossed by air routes, where Sydney is only five days from England. This is twice as rapid as the recent flights and is probably much more rapid than the earlier services are likely to accomplish regularly. I have assumed 1,500 miles in 24 hours, which makes it about four days from Calcutta to Canberra, in case of favoring winds.

First Day	
Calcutta to Rangoon, Burma	650 miles
Rangoon to Bangkok, Siam	350
Bangkok to Penang, Malay States	580
	1,580
Second Day	
Penang to Singapore, Malay States	350
Singapore to Batavia, northwestern Java	560
Batavia to Banjoewangie, southeastern Java	520
	1,430
Third Day	
Banjoewangie to Koepang, Timor	680
Koepang to Port Darwin (only oversea stage)	500
Port Darwin to Mataranka (suggested inland capital, Northern Territory)	250
	1,430
Fourth Day	
Mataranka to Cloncurry	600
Cloncurry to Longreach	300
Longreach to Brisbane	600
	1,500
Fifth Day	
Brisbane to Sydney	500
or	
Brisbane to Canberra	600
or	
Brisbane to Melbourne	900

[2] G. H. Thomas: Commercial Aeronautics (Paper Read Before the Aeronautical Society, May 30, 1917), *Flight*, No. 440, Vol. 9, 1917, pp. 536-543, London.

The Trade Wind as a Factor

Let us look more particularly into the meteorological factors on this route. It lies almost entirely in the monsoon and trade wind region, whose climates differ materially from those to which most of us are accustomed.

The trade wind is a surface wind blowing from the southeast (over Australia) to the equator (see Fig. 3). Its limits vary during the year, for the belt is farther north in winter than in summer, moving with the sun. In the southern winter (July) these winds reach the equator, that is almost to Singapore, and will obviously hinder the airplane coming from India but will help the return flight. In the southern summer (Fig. 2) their influence is not felt much north of the Tropic of Capricorn, and only the last day's journey from India will be affected. In the northern hemisphere the trade winds blowing from the northeast will be cross winds in January and will be obliterated in July by the periodical monsoons.

Very little research on the limits of the trade winds either in height or in latitude has been done in the southern hemisphere, but the following notes embody what is available.

The trade wind in northern Queensland blows on an average about 20 miles an hour for weeks at a time, but its velocity is probably less in other portions of its belt. This steady drift can obviously affect very considerably the velocity of the plane. The layer of the trade wind is, however, of limited thickness, for above it blows a poleward return wind. This is reached about 12,000 feet above sea level near the tropics (according to German data) but is lower in temperate regions. It is often reached in ascending 4,000 feet above Melbourne, and high regions like Mt. Kosciusko experience the west wind very frequently. We know nothing directly of its depth in the Australian tropics.

These heights mentioned are quite those of the regular flight zones. Hence our air captain will doubtless fly from the equator to southern Australia at high levels when the surface winds in July are against him, in this permanent anti-trade region. At these elevations wind forces are much stronger, for there is little friction due to obstructions or turbulent eddies at heights above a mile. For instance, at the upper flight limit the winds in temperate latitudes have an average of about 60 miles an hour.

The Monsoon as a Factor

During the summer seasons in the region discussed there is the maximum development of monsoons. The strong southwest monsoon of India blows during the hot months and is accompanied by dense clouds, thunderstorms, and much rain. These winds are not favorable for aviation either in direction or in their accompanying meteorology; but here again they are confined to the lower 12,000 feet, and above this (as the Dutch have shown in Java) are found trade winds. The winter monsoon is practically the same as the trade wind.

In Australia the northwest monsoon blows in the northern regions during the three hottest months. It is a layer of turbulent wind, and probably the aviator will prefer to fly above it, though the dominant monsoon wind from the northwest would help him to the south. Its extent and character can at present only be surmised.

Where the sun is vertically overhead the air is rising, and these regions, though calm at the surface, are certainly turbulent areas in the flight zone.

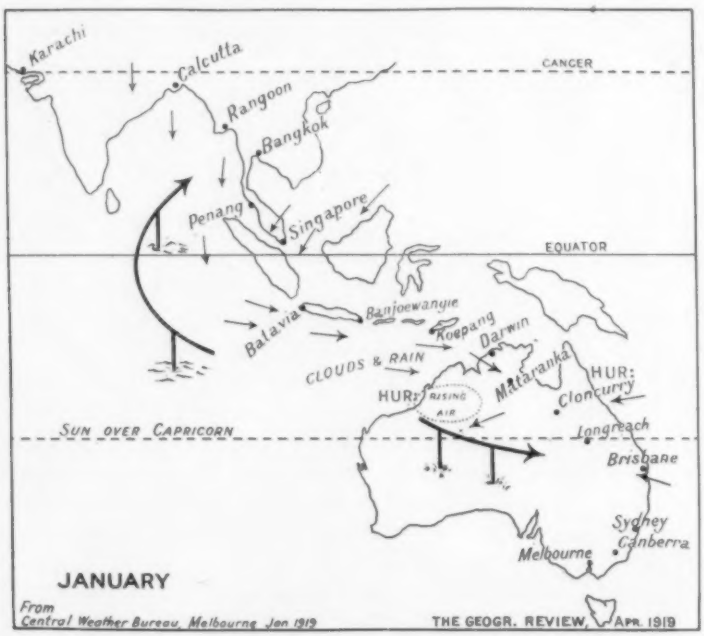

FIG. 2—Sketch map of Australasia showing the dominant winds in January. Equatorial scale, 1:100,000,000. The winds of the upper flying layers are shown on stilts. HUR=hurricane.

However, though heat bumps on a large scale may be apparent, they have not much significance for a modern plane and can be avoided by high flying.

OTHER METEOROLOGICAL CONDITIONS

The most violent storms of the tropics are the occasional hurricanes. Luckily these are confined to the oceans and rarely cause much damage far inland. They are prevalent in summer in the regions indicated, but airplanes flying overland will not often be dangerously affected. This is an unknown field of research, but one which it will be disastrous to neglect much longer.

The southern portion of Australia is dominated by anticyclones at the surface and by the westerly drift above. Here we are on more familiar

ground. The anticyclones are surrounded by variable winds, generally unimportant from the present point of view. They have clear skies and afford good flying weather. The aviator will be interested in the more intense lows (or cyclones) which periodically travel across southern Australia, but they are regularly forecast and should not catch him unprepared for their clouds, rain, and strong winds.

The writer began this article with a quotation and will conclude with

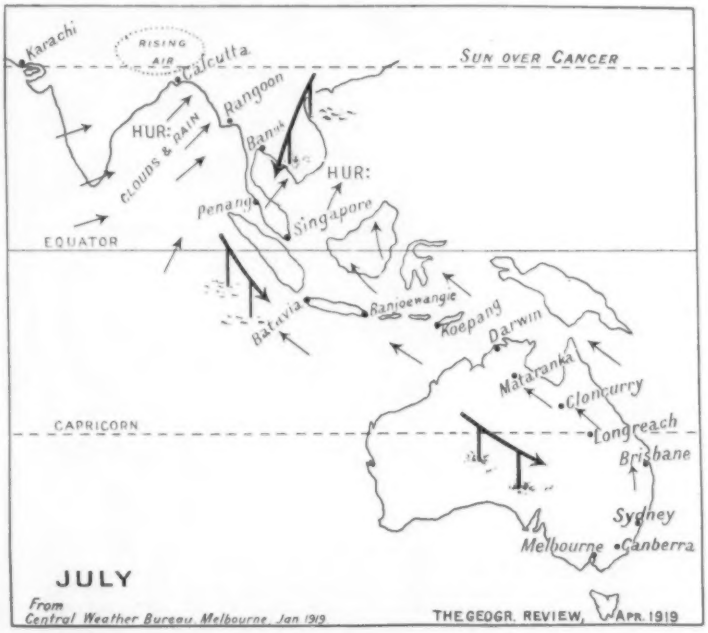

FIG. 3—Sketch map of Australasia showing the dominant winds in July. Equatorial scale, 1:100,000,000. The winds of the upper flying layers are shown on stilts. HUR=hurricane.

one. Lieutenant Colonel Mervyn O'Gorman in a note added to the Fifth Wilbur Wright Memorial Lecture stated:[3]

> Commercial aëronautics are bound up with using the [special] values which accrue incidentally to the employment of aircraft. I take three of these: (1) the speed of transit made available, (2) the directness of the route which can be selected, (3) the utilization of helpful winds and evading bad weather.

Much more might be written on this topic, but it is hoped that the reader will now realize how intimate is the connection between meteorology and aviation and also how much remains to be done in a scientific preparation for the forthcoming aërial traffic.

[3] Mervyn O'Gorman: Looking Ahead (Being the Fifth Wilbur Wright Memorial Lecture, Delivered Before the Aeronautical Society at Grafton Galleries, London, on June 13, 1917), *Flight*, No. 442, Vol. 9, 1917, pp. 599-603 and 629, London.

GEOGRAPHICAL RECORD

AMERICAN GEOGRAPHICAL SOCIETY

Award of the Cullum Geographical Medal to Emmanuel de Margerie. The Cullum Geographical Medal of the American Geographical Society for 1919 has been awarded to Emmanuel de Margerie, the eminent French authority on geographical geology, as the field has been termed that he has made peculiarly his own. M. de Margerie is a voluminous writer, a bibliography of his works to 1917 enumerating over 350 items. He is possibly best known for his masterly annotated French translation of Suess's "Das Antlitz der Erde." M. de Margerie has made a special study of the physical geography of the United States, on which subject he may without exaggeration be said to be more widely read than any other person, irrespective of nationality. In 1912 he was a member of the Society's Transcontinental Excursion across the United States.

The presentation will be made at Paris by the American Ambassador. An announcement will be made in a later issue of the *Review*.

Meetings of March. An inter-monthly meeting of the American Geographical Society was held on Tuesday evening, March 11, at the Engineering Societies' Building, 29 West Thirty-ninth Street. President Greenough presided. The lecturer of the evening was Mr. Herman Montagu Donner, the Anglo-Finnish poet and a recognized authority on Finland. The address dealt with the geography and history of Finland and the recent struggles of the Finnish people.

A monthly meeting of the Society was held on March 25. President Greenough presided. He submitted the names of 17 candidates for Fellowship, each of whom had been approved by the Council, and they were confirmed as Fellows of the Society. Thereupon Professor J. Paul Goode of the Department of Geography of the University of Chicago addressed the Society on "America as a World Power." As on the occasion of his previous lecture before the Society at the beginning of the war (*Geogr. Rev.*, Vol. 1, 1916, p. 371) maps and diagrams in the form of lantern slides were used to great advantage to make clear the multitude of geographic, ethnic, and economic factors involved.

NORTH AMERICA

Progress in Signposting the Western Deserts. The novel work of erecting sign posts in our Western deserts that will direct the traveler to watering places was mentioned in the *Geographical Review* (Vol. 4, 1917, p. 395). This movement was then only in its initial stages. Since that time the U. S. Geological Survey has continued operations, having now completed a survey of about 60,000 square miles in the Sonoran Desert province of southern California and southwestern Arizona (*U. S. Geol. Survey 39th Annual Rept.*, Washington, 1918, pp. 118-119). This province extends northwest-southeast between the Arizona Highlands and the Los Angeles ranges; on the north it is limited by the Great Basin; on the south it continues along the eastern coastal plain of the Gulf of California into the state of Sonora, Mexico. The southern end of Death Valley, at the northern end of the province, was also investigated.

"This region was selected because it is the driest, hottest, and least explored part of the desert region, and also because of the strategic importance of obtaining information on the water supplies along the 350 miles of national frontier that it includes. The field work was done by four parties, each of which consisted of one geologist and one nontechnical assistant outfitted with an automobile and light camping equipment. Practically all watering places in the region were examined, about 160 samples of water were collected and shipped to the water-resources laboratory at Washington, D. C., for analysis, and a general exploration was made of the geography, geology, and groundwater conditions of the region. The maps prepared and the data obtained were made available to the Army engineers for incorporation in the progressive military map of the United States. Guides with maps are being prepared for publication.

"Signs directing travelers to water were erected at 167 localities in California and 138 in Arizona. . . . . They are of two sizes. . . . . Most of the larger signs, of which 470 were erected, give the names, distances, and directions to four watering places; most of the smaller signs, 165 of which were erected, give the names, distances, and directions to two watering places. The work done last year is a part of a comprehensive

plan for mapping and marking the watering places in the entire arid region lying east of the Sierra Navada and Cascade Mountains and west of a line running approximately from eastern Oregon through Salt Lake City and Santa Fe to the mouth of Pecos River." (On the Western deserts in general see D. T. MacDougal: North American Deserts, *Geogr. Journ.*, Vol. 39, 1912, pp. 105-123, with map by Forrest Shreve, 1:15,000,000; on Death Valley cf.: M. W. Harrington: Notes on the Climate and Meteorology of Death Valley, California, *U. S. Weather Bureau Bull. No. 1*, 1892, and Ellsworth Huntington: Death Valley and Our Future Climate, *Harper's Magazine*, May, 1916, pp. 919-928. An excellent account of the physical geography, vegetation, and biogeography of the Sonoran Desert province is to be found in E. A. Mearns: Mammals of the Mexican Boundary of the United States, *Bull. U. S. Natl. Museum No. 66*, Part I, 1907.)

The Major Controls of the Climates of the United States. The most important controls of the climates of the United States, as given in a recent discussion of this subject by Professor Robert DeC. Ward (*Monthly Weather Rev.*, Vol. 46, 1918, pp. 464-468), are (1) latitude, (2) land and water, (3) mountain barriers, (4) altitude, (5) prevailing winds, (6) ocean currents, and (7) storms. Latitude obviously stands first. Upon it depend the prevailing annual and seasonal differences in temperature between the northern and the southern portions of the country. Yet many other factors have to be taken into account, e.g. winds, which, importing heat or cold from a distance, wipe out climatic boundaries and often to a marked degree—sometimes even completely—nullify the effects of latitude. The influence of latitude may also be wholly overcome by the effects of land and water. North America as a whole is cooler in winter and warmer in summer than the adjacent oceans in similar latitudes. The marked and systematic deflections of the January and the July isotherms clearly show this. Neither the Pacific nor the Atlantic Ocean can attain its maximum control over the climates of the continent—the former, because of the presence of the mountain barrier near the west coast; the latter, because it is on the lee side of the continent. The Gulf of Mexico has a marked influence over the rainfall and the temperatures of the eastern United States. To the south, southeast, and southwest winds which prevail over the eastern sections in summer, much, if not most, of the warm-season rainfall is due. Furthermore, throughout the year and especially in winter, temporary warm and damp winds, associated with passing storm conditions, blow with considerable frequency from southerly directions and carry the warming influence of the Gulf far northward. The Great Lakes are of relatively subordinate climatic significance as major controls but show local effects of distinct economic importance. Among these effects are the later occurrence of the first killing frost in autumn and the earlier date of last killing frost in spring, in favored localities to leeward of the Lakes.

The Sierra Nevada-Cascades are the most important climatic barrier in the country, as they prevent the influence of the Pacific Ocean from being carried far inland. Thus the Pacific Slope climates are sharply defined and are separated from the interior, where the rainfall is less and the ranges of temperature are greater. The Rocky Mountains, together with their subsidiary ranges, are less significant as a climatic barrier than they would be were there no Pacific ranges. The Appalachians are not effective. They are not high. They are near the leeward margin of the continent. They are more or less parallel, during much of the year, to the direction of the prevailing winds. The greatest and most widespread effects of altitude are naturally found in the western plateau and mountain region, where the varied topography gives rise to a great variety of local climates. Prevailing winds have marked climatic effects. In summer, the prevailing wind may be a warm one, as over most of the eastern United States, and the summer heat is therefore increased. Or the prevailing winter wind may be a cold one, as in New England, thus making the winters more severe.

A glance at the isothermal charts of the world at once shows the effects of ocean currents in deflecting the isotherms along the coasts of the United States. Off the Pacific coast the isotherms are carried poleward by the warm eddy which sweeps around the Gulf of Alaska and equatorward by the southward-flowing current along the coast of southern California. The result is a spreading of the isotherms and a weak poleward temperature gradient. The Gulf Stream carries the isotherms northward along the southern and central Atlantic coasts, while the Labrador Current carries them southward along the coast of New England and of the Canadian provinces. It is partly for this reason that there is such a very rapid temperature gradient northward along this coast, amounting to 2.7° F. per latitude degree in January.

Cyclones and anticyclones are essential controls of climate in the latitudes of the "prevailing westerly" winds. Climate is average weather, and the different weather types give climates their distinctive characters and to a large extent determine the amount and distribution of temperature, of rain and snow, of humidity, of cloudiness.

This latter subject has been more fully discussed by Professor Ward in a paper entitled "The Weather Element in American Climates" (*Annals Assoc. Amer. Geogrs.*, Vol. 4, 1915, pp. 3-54).

Smoke from the Minnesota Forest Fires of October, 1918. Between October 13 and 17, 1918, smoke clouds from forest fires in Minnesota and the adjacent sections of Wisconsin spread over a large portion of the United States east of the Missouri River. As stated in Mr. Richardson's article above, the fires started on October 12, following an exceptionally severe drought during which the precipitation had averaged only 20 to 25 per cent of the normal. At Duluth the smoke became dense about the middle of the afternoon. By the morning of the 13th the smoke-cloud had overspread the Michigan Peninsula and central Indiana. In twelve hours more, strong northwest winds had carried this cloud across Ohio into New York, Pennsylvania, West Virginia, Maryland, and the District of Columbia. The two latter sections were reached shortly after 10 P. M. On the morning of the 14th, the smoke had spread as far south as Charleston, S. C., and Little Rock, Ark., and in another day more than 300 miles farther. On the 15th easterly winds set in in western Minnesota. The smoke cloud was carried across North Dakota on the 16th and into Nebraska on the following day. The transportation of smoke clouds eastward from forest fires in the Northwest has often been observed in the United States, especially during dry spells in the late summer and autumn months. The peculiar feature of the phenomenon in October, 1918, was the extraordinary rapidity of the eastward and southeastward progression of the smoke. The meteorological conditions which prevailed during this particular period are considered and many details regarding the occurrence are given in a recent discussion by Mr. Herbert Lyman (*Monthly Weather Rev.*, Vol. 46, 1918, pp. 506-509). R. DEC. WARD

A Memorial to Major Powell at the Grand Canyon. On May 20, 1918, upon the border of the Grand Canyon of the Colorado there was dedicated a simple monument to the memory of John Wesley Powell, first explorer of that gorge. It consists of a truncated pyramid built of rough-hewn native stone and standing on the rim of the canyon at Sentinel Point, about a mile west of Grand Canyon station. A bronze tablet bears a low-relief portrait of Powell and the names of the other men who took part in his two expeditions down the dangerous course of the river. Mr. Frederick S. Dellenbaugh, late librarian of the American Geographical Society and one of the survivors of those explorations, writing in the *American Anthropologist* for October-December, 1918 (pp. 432-436), fittingly speaks of the monument as "marking the conclusion of a great epoch in the history of the United States, the epoch of western exploration and exploratory development." The story of Powell's voyage down the canyon in 1869, his more complete survey of 1871, and subsequent work conducted under his guidance is told in his own report to the Smithsonian Institution entitled "Exploration of the Colorado River of the West and Its Tributaries" (Washington, 1875). This volume has long been out of print, but a later edition, "First Through the Grand Canyon," edited by Horace Kephart, was published in 1915. F. S. Dellenbaugh in the "Romance of the Colorado River" (New York, 1902) and "A Canyon Voyage" (New York, 1908) gives the history of Powell's two expeditions, including also an account of other attempts to navigate the gorge and a full description of the canyon.

Though the descent of the Colorado was the most picturesque of Powell's achievements, it was by no means the most important. Largely through his efforts was brought about the co-ordination of the various federal surveys which up to 1879 had been engaged in the exploration of the national domain and which were merged in that year to form the United States Geological Survey. In this connection it is interesting to note that, according to Gilbert, Powell's plan for the organization of the Geological Survey, which was not adopted in full, included the formation of three bureaus to conduct investigations in the fields of geology, geography, and ethnology. His activities as director of that survey from 1881 until 1894 and of the Bureau of Ethnology from 1879 to 1902, the year of his death, constitute a notable contribution to science. A biographical sketch by G. K. Gilbert is contained in the *Annual Report of the Smithsonian Institution for 1902* (pp. 633-640) and one by W. M. Davis is given in the Biographical Memoirs of the National Academy of Sciences (Washington, 1915).

SOUTH AMERICA

Rainfall of Chile. In the general distribution of its rainfall, Chile presents many striking analogies with the Pacific coast of the United States. From the heavy rainfall of the southern Chilean provinces to the aridity of the northern nitrate provinces there is the same general gradation as is seen in passing from the rainy northwestern coast

of Washington to the dry districts of Southern California and of Lower California. There have recently been published monthly rainfall values for Chile for the period 1910-15, together with a complete summary of the available annual values from 1849 to 1915 (*Inst. Meteorol. y Geofis. de Chile Publ. No. 20*, Santiago, 1917). Mr. R. C. Mossman has reviewed these new data (*Quart. Journ. Royal Meteorol. Soc.*, Oct. 1918, pp. 294-302), thereby extending a previous paper of his on the climate of Chile (*Journ. Scottish Meteorol. Soc.*, Vol. 15, 1911, pp. 313-346) in which he discussed the pressure, wind, and other conditions which control the annual and seasonal rainfall of that country.

The rainfall of Chile in middle latitudes is very variable, years of *mean* annual precipitation being comparatively rare, while there is a pronounced tendency to years of drought and of excessive rainfall. In the rainy season, which is from May to August in latitudes 27°-40° S. (and probably as far as 44° S.), 95 per cent of the annual fall occurs at Serena (30° S.), the proportion diminishing steadily as one goes south. A five-year record for Cabo Roper (46°49′ S.) shows an equable distribution through the year. The annual number of rainy days increases from 5 at Caldera (27° S.) to 315 at Evangelists' Island (52°24′ S.). There is much interest in the region of maximum rainfall in Chile, which ought also to prove to be the wettest in the whole continent of South America. Data are still incomplete, but more than 200 inches of rain in one year have been recorded at three points between latitudes 42°30′ and 52°30′ S.

R. DEC. WARD

EUROPE

The Geography of the Waldensian Valleys in the Italian Alps. In the article on "The Regions of Mixed Populations in Northern Italy" by Professor Marinelli in the March number of the *Review* mention was made (p. 147) of the Waldensians, the French-speaking, Protestant sect in the Italian Alps inhabiting the upper basin of the Pellice, a tributary of the Po, and the contiguous valley of the Germanasca. It is the inaccessibility of their valleys from the lower plains on either side of the Cottian Alps that has kept the Waldensians isolated ethnically, linguistically, economically, and in religion from the surrounding communities. An excellent geographical study of this group has recently been published by a native of the district (G. B. Roletto: Ricerche antropogeografiche sulla Val Pellice, *Memorie Geogr.* (Suppl. alla *Riv. Geogr. Ital.*) *No. 35*, Florence, 1918).

Springing from glacial lakelets on the slopes of Monte Granero the Pellice first flows north and then in a generally easterly direction, receiving tributaries from the valleys on either side, for a distance of 42 miles, in which it drops 7,860 feet till it empties into the Po. The rapid descent differentiates sharply the character of the three successive divisions of the valley, marked by the towns of Bobbio, Villar, and Torre respectively: the upper valley, which is wholly pastoral; the middle valley, where agriculture and pastoral pursuits exist side by side; the lower valley, where agriculture and industrial pursuits are combined. The last stretch of the Pellice, being outside the valley, is not considered. The triple division is emphasized in every geographical aspect of the problem. It applies also to religious conditions, the upper valley being almost wholly Waldensian in the schools and public institutions as well as the churches, while in the middle valley Waldensians and Catholics are nearly equal and in the lower valley the Catholics prevail.

As in other high Alpine valleys, *transhumance*, or seasonal migration from one level to another, is the controlling factor in the economy of the upper valley—to select only one element of this comprehensive study for discussion (see the note on "Illustrations of Seasonal Migration from Switzerland and the Dinaric Countries," *Geogr. Rev.*, Vol. 6, 1918, pp. 73-74). Because of its two phases, involving a division of labor between the men and the other members of the family, the author terms this type of migration agricultural-pastoral nomadism (illustrated by a diagram, Fig. 6, p. 53). Late in April each family leaves its permanent dwelling in the valley bottom or on the lower slopes and goes up to the level of the *fourèsts*, the temporary summer huts. Here the women and children stay to tend the herd and to start the garden. The men and some of the women return to the valley bottom during the first half of May to cut the first crop of hay. At the end of the month the men descend to the plain (the Plain of the Po) to get the cattle from the winter pasture. The ascent of the whole family to the highest level of summer activity, the alp, takes place in the second half of June. As soon as the herd is properly established there the men return to the *fourèst* level to cut their second crop of hay. The descent of the herds from the alp to the *fourèst* takes place in the second half of August. The men have already begun to reap the grain, in which they are now assisted by the whole family. The potatoes are dug up and the ground prepared for oats and rye. At the first autumnal rains the whole family descends to the

permanent dwelling. The third crop of hay is cut soon after. At the beginning of November the herds are taken down to the plain.

In this connection it is of interest to note that the *fourèsts*, although now temporary habitations only, were once permanently occupied. In the seventeenth century floods and, particularly, the pestilence of 1630 drove the inhabitants to occupy the higher levels. The high mortality of this period was not overcome until the end of the century, when a population increase led to the re-occupation of the valley bottoms.

Early Maps of Scotland. The Royal Scottish Geographical Society has recently undertaken to augment its collection of old maps of Scotland. Starting with a nucleus of 28 maps dating earlier than 1836, all but five of them prior to 1800, the committee organized for the purpose has been able to obtain, either by gift or purchase, some very interesting maps and plans. A description by Mr. Harry R. G. Inglis of those already in the Society's collection is contained in the *Scottish Geographical Magazine* for June, 1918 (pp. 217-230). Succeeding numbers of the magazine (Oct., 1918, pp. 378-386, and Feb., 1919, pp. 41-46) give some account of those maps which, either because of their value as bases for later work or because of unique features, are of peculiar interest.

Among rare maps of Scotland already secured in this campaign is one by an unknown Italian cartographer apparently issued between 1560 and 1570 and evidently based on a still earlier unidentified map (*ibid.*, Dec., 1918, p. 466; reproduced in Feb., 1919, number). Another that has attracted attention is one of Scotland by the French cartographer Barbie du Bocage, whose best known works are the maps of Greece in Barthelemy's "Voyage du Jeune Anacharsis en Grèce" (Paris, 1799). The Scottish Society has thus far been unable to discover any mention of a map of Scotland in lists of those made by this geographer.

It may be of interest to members of the American Geographical Society to know that in the map collection of this Society are found 14 out of the 23 early maps of Scotland in the original collection of the Scottish Geographical Society. Of the eight of earliest date all but one (that of Nagel, of which no other copy is known) are in the American Geographical Society's collection. In addition the Society possesses the following maps of Scotland dating earlier than 1700: Ortelius, 1579 and 1584 editions of atlas; Mercator, 1613 and 1633 editions of atlas; Speed, 1676; Coronelli, c. 1692.

AFRICA

Cape-to-Cairo Air Routes. In connection with Dr. Taylor's article on "Air Routes to Australia" in this number of the *Review* and the recent airplane flights in four days from England to India, to which he also refers, the plans for an air route from Cairo to Cape Town are of interest. They were outlined in an address to the African Society of London on January 7, 1919, on "Commercial Aviation in the Light of War Experience" by Major-General Sir F. H. Sykes, Chief of the British Air Staff (*The Africa World*, Jan. 11, 1919, p. 341, London; see also Jan. 18 issue, p. 382).

The flights will be undertaken both by flying boat and by airplane. In each case the route follows the Nile to Lake Tanganyika. It is hoped to provide landing places every 200 miles in this stretch, at Assuan, Wadi Halfa, Abu Hamed, Khartum, Kodok (Fashoda), Lake No, Bor (6° N.), Lake Albert, Jinja (at Nile outlet of Lake Victoria), Ujiji on Lake Tanganyika. The route for the flying boat will then be Karonga (at the head of Lake Nyassa), Blantyre, Beira, Lourenço Marques, Durban, Port Elizabeth, Cape Town, 5,700 miles in all; and for the airplane: Elizabethville, Livingstone, Buluwayo, Johannesburg, Bloemfontein, Cape Town, 5,300 miles. Survey parties have already been sent out from Cairo to inspect and arrange possible landing places.

The Cape-to-Cairo route will form part of a through air service from London to Cape Town. A preliminary flight, estimated to take 7-14 days, will soon be made by a Handley-Page machine under the auspices of the British Air Ministry. The calling places on the way to Cairo will be Marseilles, Naples, and Crete. Ultimately it is expected that the distance of 7,000 miles between London and Cape Town will be covered in six days (this is about the same average speed as that assumed by Dr. Taylor between Calcutta and Brisbane).

GEOGRAPHICAL NEWS

Officers of the Association of American Geographers for 1919. The following were elected officers of the Association of American Geographers at the fourteenth annual meeting at Baltimore, December 27-28, 1918: President, Professor Charles R. Dryer; First Vice-President, Dr. Herbert E. Gregory; Second Vice-President, Dr. Isaiah Bowman; Secretary, Dr. Oliver L. Fassig; Treasurer, Mr. François E. Matthes; Councilor for three years, Professor Eliot Blackwelder.

Creation of a Mexican Bureau of Archeology and Ethnography. The Government of Mexico, through its Department of Agriculture and Development (Fomento), has organized a bureau of archeological and ethnographical studies (Secretaría de Agricultura y Fomento: Programa de la Dirección de Estudios Arqueológicos y Etnográficos, formulado por el Director Manuel Gamio, 44 pp., Mexico, 1918). The purpose of this bureau will be to carry on scientific investigations regarding the aboriginal races of the republic, their geographical environment, their culture, languages, monuments, history, and their present social and economic condition as related to their importance in the development of national unity. The work will be undertaken on the basis of regional surveys covering the above points. As nearly 40 per cent of the inhabitants of Mexico are of pure Indian stock and about an equal proportion are of mixed race, the Indian element predominating, such a study as that contemplated should yield important results both to the sciences concerned and in the welfare of the republic.

Personal

Dr. William T. Brigham, in charge of the Bernice Pauahi Bishop Museum of Honolulu since its foundation, has resigned the directorship of the institution, and the trustees have conferred upon him the title of Director Emeritus. Dr. Brigham continues his connection with the museum as Curator of Anthropology.

The Hon. H. Burton, South African Minister of Railways and Harbours, delivered a lecture on "Railways and Communications in South Africa" before the African Society of London at its first luncheon meeting in 1918.

Mr. William Crooke, late of the Bengal Civil Service, has received the honorary degree of D.Sc. from the University of Oxford in recognition of his researches on the anthropology of the native races of India. Among other works he has written: "The Northwestern Provinces of India: Their History, Ethnology, and Administration," London, 1897, and "Natives of Northern India" (in series "The Native Races of the British Empire"), London, 1907.

Dr. J. J. Galloway of the Department of Geology of Columbia University spent the summer of 1918 in the peninsula of Yucatan studying its geology and petroleum resources.

Dr. Aleš Hrdlička of the United States National Museum read a paper on "The War and the Race" before Section H of the American Association for the Advancement of Science at its seventy-first meeting at Baltimore, December 23-28, 1918.

Sir Harry Johnston, the noted authority on colonial Africa, who was elected president of the African Society of London for 1919, delivered an address before that body entitled "The Importance of Africa" at the first of a series of luncheon meetings held by that Society in 1918.

Mr. E M. Lehnerts, director and editor of the *Bulletin of the American Bureau of Geography*, 1900-1901, and joint editor of the *Journal of Geography*, 1902-1904, read a paper on March 17 before the New York Academy of Sciences entitled "Some Field Studies in Glacier [National] Park."

Mr. Philip Ainsworth Means sailed on March 15 from New Orleans for Peru and Ecuador, where he will undertake general historical and archeological studies. Mr. Means contributed an article entitled "A Note on the Guaraní Invasions of the Inca Empire" to the December, 1917, *Review*, and is the author of "An Outline of the Culture Sequence in the Andean Area" (reviewed in the *Geogr. Rev.*, Vol. 4, 1917, p. 500).

Professor J. C. Merriam of the University of California read a paper on "Race Origin and History as Factors in World Politics" before Section H of the American Association for the Advancement of Science at its seventy-first meeting at Baltimore, December 23-28, 1918.

Mr. William P. Northrup, first vice-president of the Matthews-Northrup Works of Buffalo, New York, was the guest of honor at a dinner tendered by his associates in December, 1918, at the completion of his fiftieth year of connection with the J. N. Matthews Company, owners of the Matthews-Northrup Works. The Matthews-Northrup Works are one of the leading commercial map-making firms in this country using the wax-engraving process. One of their foremost productions is the Century Atlas.

Dr. H. J. Spinden of the American Museum of Natural History read a paper on February 24 before the American Ethnological Society on "The Indians of Eastern Nicaragua."

MR. VILHJÁLMUR STEFANSSON was awarded—in addition to the Charles P. Daly Medal of the American Geographical Society (cf. Jan. *Review*, p. 48)—the Hubbard Gold Medal of the National Geographic Society of Washington on January 10, the Elisha Kent Kane Medal of the Geographical Society of Philadelphia on January 24, the Helen Culver Gold Medal of the Geographic Society of Chicago on March 10, and the gold medal of the Explorers' Club of New York, in recognition of his Arctic explorations.

DR. H. N. WHITFORD of Yale University read two papers before the meeting of the Society of American Foresters, held in conjunction with the American Association for the Advancement of Science at Baltimore, December 27-28, 1918, entitled "Forest Formations in British Columbia," and "The Structure and Value of the Paraná Pine Forests of Brazil." The latter paper was based on the results of a six months' trip made in the summer of 1918 in behalf of the Yale Forestry School. The Paraná pine (Araucaria) forest is the most extensive coniferous forest in the southern hemisphere and covers a region of not less than 100 square miles.

OBITUARY

THEODOOR DE BOOY died suddenly from the effects of influenza at Yonkers, N. Y., on February 18, at the age of 36. Although his field of work was archeology, his extensive travels, especially in the West Indies, gave him an intimate knowledge of the geography of those regions. From 1912 to 1918 he was a member of the staff of the Museum of the American Indian, Heye Foundation, of New York City, as field explorer for West Indian work. In 1911 and 1912 he visited the Bahamas, especially the Caicos group; in 1913 and 1914, Jamaica, Santo Domingo, and eastern Cuba; in 1915, the island of Margarita, Venezuela, and Trinidad; in 1916 and 1917, Porto Rico, Martinique, and the Virgin Islands. In 1918 he undertook, under the auspices of the American Geographical Society and the University of Pennsylvania Museum, an expedition to the Sierra de Perija between Colombia and Venezuela to explore the unknown interior of the range and study the Motilone Indians, the savage remnant of a tribe which has always kept their country free from white settlement and exploration. The geographical aspects of this trip were described in the November and December, 1918, issues of the *Geographical Review*, the ethnologic in the *University of Pennsylvania Museum Journal* for September-December, 1918. Among the author's large number of publications the following are of geographical interest: Island of Margarita, Venezuela (*Bull. Pan. Amer. Union*, April, 1916); The Birthplace of Josephine, Empress of France [Martinique], *ibid.*, April, 1917; Eastern Part of the Dominican Republic, *ibid.*, Sept., 1917; The Town of Baracoa and the Eastern Part of Cuba, *ibid.*, Nov., 1917; The Virgin Islands of the United States, *Geogr. Rev.*, Nov., 1917; The Turks and Caicos Islands, *ibid.*, July, 1918; The Virgin Islands: Our New Possessions (joint author with J. T. Faris), Philadelphia, 1918; The Less Known Regions of the West Indies, *Journ. of Geogr.*, Feb., 1919; Tropical versus Arctic Exploration, *The Scientific Monthly* (to be published); On the Possibility of Determining the First Landfall of Columbus by Archaeological Research, *Hispanic Amer. Hist. Rev.*, Feb., 1919.

DAVID LUBIN of San Francisco, founder of the International Institute of Agriculture in Rome and the American representative on its permanent board, died in Rome on December 31, 1918, in his seventy-seventh year. The International Institute of Agriculture is an organization which collects agricultural information of every sort from all parts of the world. Its regular publications are of great value to geographers because of their international scope. (For an account of the organization see "The International Institute of Agriculture: Its Organization, Activity, and Results," 45 pp., Rome, 1915.)

GEOGRAPHICAL PUBLICATIONS

(Reviews and Titles of Books, Papers, and Maps)

For key to classification see "Explanatory Note" in Vol. II, pp. 77-81

NORTH AMERICA

UNITED STATES

General

VAN CLEEF, EUGENE. ***Normal annual precipitation map of the United States.*** Polyconic projection. Base map by J. Paul Goode. 1:3,015,936 [*sic*]. Rand, McNally & Co., New York, 1915.

Meteorological instruction, both in our schools and in our colleges, has been hampered by a lack of suitable wall maps, presenting the essential meteorological and climatological data and published at a reasonable price. In many cases it has been necessary for teachers of meteorology to have enlarged maps made for their own use at a considerable expenditure of time or money or both. Within the last few years, however, a good many of these necessary wall maps have become available at a reasonable price. We now have the excellent series of Oxford Wall Maps, prepared by the late Dr. A. J. Herbertson, and the new set of climatic charts published by Philip and Son of London. We still lack a set of type weather maps suitable for wall use, like Börnstein's excellent series for Europe, published some years ago, and essential in any class-room study of the climatology of Europe. Nevertheless, in spite of this great advance of recent years, there is still need of more such maps, especially of temperature and of rainfall of the various continents, on a larger scale than those above referred to and printed on base maps which give more detail regarding the locations of boundaries, rivers, and important cities. Hence teachers in this country will welcome Mr. Van Cleef's new wall map of the mean annual rainfall of the United States as giving a striking picture of the larger facts of our rainfall distribution.

Many small-scale rainfall maps of the United States have been published during the last few decades. These have differed a good deal from one another, not only because the available rainfall data varied in number and in accuracy but also because the general principle upon which the maps were constructed differed. Some authorities have limited themselves fairly, or absolutely, rigidly to the observed rain-gage readings. Others, on the other hand, using actual observations as far as these went, also took account, in drawing their isohyetal lines, of known facts of topography, stream flow, wind direction, vegetation, and other conditions, inferring the amounts of precipitation over the higher mountain slopes and summits and over unoccupied or thinly settled areas. Thus the maps constructed by what may be called the strictly meteorological group have differed, in general, from those drawn by the second, or geographical, group chiefly in the fact that topographic controls were less completely indicated on the former.

Mr. Van Cleef's map belongs to the second group rather than to the first in that he has clearly brought out many of the more striking topographic controls of rainfall, although many details of such controls are not included. The larger facts on this map stand out very clearly because of the use of eight different colors or shades of color, ranging from bright yellow (under 10 inches) to a darkish blue (over 80 inches). There are advantages, as well as disadvantages, in the use of colors which differ so much from one another as do the blues, greens, and yellows on this map. The obvious advantage is the distinctness with which the different grades of rainfall stand out. The disadvantage is that the contrast between the colors is so marked that the eye gives us an almost unavoidable impression of a sudden change in rainfall amount as one color changes to another on the map. It is essential, in a proper understanding of rainfall distribution, that the idea of a gradual transition from one isohyetal line to the next should always be kept in mind. It is in order to avoid this disadvantage of employing sharply contrasted colors that many rainfall maps are colored altogether in different shades of blue. However, as before stated, the advantage of seeing the facts clearly and at once, is a very considerable one, and there will always be much to be said in favor of the use of striking color contrasts. Mr. Van Cleef has wisely extended his rainfall lines a little distance into Canada and as far south as the Tropic of Cancer. It is a mistake to cut off so many of our climatic charts at the Canadian and the Mexican frontiers. There are no climatic barriers along these frontiers.

The data used in the preparation of the map were taken from *Weather Bureau Bulletin W* for the United States; from the Canadian Meteorological Service's publications for Canada, and from Bartholomew's "Atlas of Meteorology" for areas outside of the United States and Canada. There is no statement regarding the use of a uniform period of observation, nor of any reduction of the data to a uniform period. We must assume, therefore, that the data used in the construction of the map cover varying numbers of years of observation and are not reduced. It is, of course, most unfortunate that the map had to be constructed on the basis of raw data which were not treated in accordance with well-recognized climatological principles. An answer to such criticism, so far as there is any answer, might be found in the statement that, for ordinary teaching purposes, the larger facts of our mean annual rainfall distribution are sufficiently accurately indicated on this map as it stands, without the need of the very tiresome and time-consuming labor necessary in order to reduce the data to a homogeneous system.

Since the publication of Mr. Van Cleef's map (1915) the new mean annual precipitation chart of the "Atlas of American Agriculture" has appeared. In this, the records either covered the same period of 20 years (1895-1914) or were reduced to the same period. This standardization of all the data, the use of a very large number of stations, and the inclusion of records extending through 1914, combine to make the new chart from the atlas the most accurate one which we have ever had for the United States. Mr. Van Cleef's map has not, however, lost its usefulness. It still presents the larger facts with sufficient accuracy for most general purposes, and its large scale makes it useful in the classroom, whereas the newer map is on too small a scale to be seen across a large room. R. DEC. WARD

BAKER, O. E., C. F. BROOKS, AND R. G. HAINSWORTH. **A graphic summary of seasonal work on farm crops.** 55 pp.; maps, diagrs. Separate from *Yearbook of Dept. of Agric., 1917*, No. 758, Washington, D. C., 1918. [A series of maps shows the time distribution of the chief seasonal operations in the cultivation of the staple crops of the United States. "The most striking feature of the maps is the northward and upward movement of spring operations and events and the southward and downward progress in autumn. This movement progresses at a rate of approximately 1 degree of latitude or 400 feet of altitude in four days. Local climatic influences of the Great Lakes and of the Atlantic Ocean are evident on almost every map. In operations which may be performed during a long period the maps indicate for the most part only the effect of local competition for labor by other crops, although the underlying control of general climatic conditions is not wholly obscured. Local markets may hasten the harvest of certain crops, such as potatoes, near the large cities." Seasonal distribution of labor is also shown graphically for typical agricultural areas.]

BOWLES, OLIVER. **Rock quarrying for cement manufacture.** xiii and 160 pp.; diagrs., ills., index. *Bur. of Mines Bull. 160*, Dept. of the Interior, Washington, D. C., 1918. [Includes a brief historical statement concerning the phenomenal growth of the Portland cement industry in the United States. According to preliminary estimates of the U. S. Geological Survey the output of this material in 1917 had reached a total of 93,500,000 barrels.]

DALE, H. C., edit. **The Ashley-Smith explorations and the discovery of a central route to the Pacific, 1822-1829; with the original journals.** 352 pp.; maps, ills., bibliogr., index. Arthur H. Clark Co., Cleveland, 1918. $5.00. 9½ x 6. ["Ashley and his men plotted the course as far as Green River and the Great Salt Lake by way of the North Platte and the South Platte; Smith, Ashley's successor in business, continued the latter's explorations, reaching California by way of the Colorado River and the Mohave Desert, returning from central California, eastward, across the present state of Nevada, to the Great Salt Lake again. A second expedition carried Smith, the first white man, the entire length of California and Oregon to the Columbia" (p. 14). The account of these explorations is preceded by a chapter on the fur trade and the progress of discovery to 1822. The "physiographic map" accompanying the text is a route map on which drainage basins are also defined.]

GREGG, W. R. **Mean values of free-air barometric and vapor pressures, temperatures, and densities over the United States.** *Monthly Weather Rev.*, Vol. 46, 1918, No. 1, pp. 11-20. Washington, D. C. [Average values as determined from all available observations thus far made by the U. S. Weather Bureau in this country.]

GULICK, S. L. **American democracy and Asiatic citizenship.** xii and 257 pp. Charles Scribner's Sons, New York, 1918. $1.75. 8 x 5½.

HENRY, A. J. **Hot spell of August, 1918.** *Monthly Weather Rev.*, Vol. 46, 1918, No. 8, pp. 361-363. Washington, D. C.

HORWILL, H. W. **A negro exodus.** *Contemporary Rev.*, No. 633, Vol. 114, 1918, Sept., pp. 299-305. London. [Unsatisfactory economic and social conditions in the South made the negro discontented. Extensive floods and the depredations of the boll weevil suddenly accentuated the difficulties of living just at the moment that immigration ceased and labor shortage in the North was increased by our entrance into the war. The negro responded to these conditions by migrating northward. No census has been taken, but the number is variously estimated at from 250,000 to 500,000.]

KEIR, MALCOLM. **The localization of industry.** *Scientific Monthly*, Vol. 8, 1919, No. 1, pp. 32-48.

LESHER, C. E. **Coal in 1916.** *Mineral Resources of the United States, 1916*, Part II, pp. 901-991. U. S. Geol. Survey, Washington, D. C., 1918.

NORTON, W. H. **Earth science in American colleges and universities.** *School and Society*, No. 207, Vol. 8, 1918, December 14, pp. 702-706.

PELZER, LOUIS. **Marches of the dragoons in the Mississippi Valley.** x and 282 pp.; index. State Historical Society of Iowa, Iowa City, 1917. $2.50. 9 x 6. [Work of the frontier army, one of the factors in the westward spread, 1833-1861.]

PRATT, E. E. **The export lumber trade of the United States.** 117 pp.; maps, ills. *Bur. of Foreign and Domestic Commerce Misc. Ser. No. 67.* Dept. of Commerce, Washington, D. C., 1918.

SMITH, G. O. **The economic limits to domestic independence in minerals.** *Mineral Resources of the United States, 1917*, Part I, pp. 1a-6a. U. S. Geol. Survey, Washington, D. C., 1918.

SULLIVAN, L. R. **Racial types in the population of the United States.** Maps. *Amer. Museum Journ.*, Vol. 18, 1918, No. 6, pp. 429-446.

TEELE, R. P. **Irrigation in the United States: A discussion of its legal, economic and financial aspects.** xi and 252 pp.; map, diagr., index. D. Appleton & Co., New York and London, 1915. $1.75. 8 x 5.

—— **United States, Foreign commerce and navigation of the, for the year ending June 30, 1917.** lv and 956 pp.; index. Bur. of Foreign and Domestic Commerce, Dept. of Commerce, Washington, D. C., 1918. $1.50. 12 x 9.

WARD, R. DEC. **Major controls of the climates of the United States.** *Monthly Weather Rev.*, Vol. 46, 1918, No. 10, pp. 464-468. [Abstracted on pp. 263-264, above.]

MULFORD, J. C., Chief Cartographer; G. E. LOMBARD, J. M. DARLEY, E. E. JENKINS, Cartographers. ***National highways map of the United States showing one hundred fifty thousand miles of national highways, proposed by the National Highways Association.*** 1:3,750,000. Washington, D. C., 1918. [One of the most detailed maps of the United States as a unit issued by the Association. "The proposed National Highways shown on this map are substantially all present existing roads. Less than 1,000 miles are projected highways." Towns along the roads are shown in great number. Among the other innumerable highway maps issued by the Association are another map of the United States on the same scale, published in 1915, showing fewer roads and distinguishing the principal transcontinental highways; maps showing individual highways; and maps showing the highways in individual states. The legend—when there is any—is on many of the maps obscured by a profusion of publicity text.]

North Atlantic States

TAYLOR, NORMAN. **Flora of the vicinity of New York.** Map. *Scientific Monthly*, Vol. 4, 1917, No. 6, pp. 548-553.

This paper has geographical aspects of special interest to students of regional geography. The pine barrens of New Jersey are described as occupying the Beacon Hill formation, which is the oldest region of the coastal plain that can have been continuously covered with vegetation since its origin. About eight per cent of the native vegetation consists of northern species that reach their local limit within the floral area of New York, and many more are found within the mountains to the south. Likewise many southern species reach their extreme northern distribution in the same area. At the present time "over thirteen per cent of our local plants reach their northern limits within one hundred miles of the City of New York." The paper deals not only with the geologic and physiographic controls of vegetation in the past but also with the climatic influence of the present. The most important control seems to be the rather

well-defined temperature barrier through which some plants have never been known to go. Among the climatic factors the length of the growing season appears to be the most important. It is pointed out that there is a difference of three months in the growing season between the Catskills and Cape May. The paper is accompanied by a map illustrating the length of the growing season within one hundred miles of New York.

ABBOTT, C. C. **The archaeological significance of an ancient dune.** *Proc. Amer. Philos. Soc.*, Vol. 57, 1918, No. 1, pp. 49-59. Philadelphia. [Delaware River.]

ALLING, H. L. **The Adirondack graphite deposits.** 150 pp.; maps, diagrs., index. *New York State Museum Bull. No. 199.* Albany, 1918. 9 x 6.

BISHOP, J. B. **A chronicle of one hundred and fifty years: The Chamber of Commerce of the State of New York, 1768-1918.** xvi and 311 pp.; ills., index. Charles Scribner's Sons, New York, 1918. $5.00. 9 x 6.

BONSTEEL, J. A. **Soils of southern New Jersey and their uses.** 78 pp.; maps, ills. *U. S. Dept. of Agric. Bull. No. 677* (Contribution from the Bur. of Soils). Washington, D. C., 1918. [This monograph with its nine maps and many well-chosen illustrations differs from the usual soil survey in the greater stress given to the relation between soils and crop selection. In the region studied difference in the character of the soil seems to be the most potent control in that matter. Climatic differences are slight. Distance from market and means of communication vary little. But there is a decided diversity of soil-forming materials, resulting in a number of distinct soil types. Each of these possesses its special type of agricultural occupation. The series of maps shows graphically how closely crop distribution is related to the character of the soil.]

CRESSON, B. F., JR. **Sandy sea coast shore protection.** Maps, diagrs. *Proc. 2nd Pan. Amer. Sci. Congr., Dec. 27, 1915, to Jan. 8, 1916*, Vol. 6, Section 5: Engineering, pp. 774-784. Washington, D. C., 1917. [The problem in New Jersey.]

EMERSON, B. K. **Geology of Massachusetts and Rhode Island.** 289 pp.; maps, diagr., ills., index. *U. S. Geol. Survey Bull. 597.* Washington, D. C., 1917.

FAIRCHILD, H. L. **Postglacial features of the upper Hudson Valley.** 22 pp.; map, bibliogr., index. *New York State Museum Bull. No. 195.* Albany, 1917.

GAGNON, ALPHONSE. **La question du Vinland.** *Bull. Soc. de Géogr. de Québec*, Vol. 12, 1918, No. 4, pp. 211-216. [Cf. a previous article by the same author listed in the *Review*, Vol. 5, p. 428, with comment.]

GOLDTHWAIT, J. W. **Glaciation in the White Mountains of New Hampshire.** Maps. *Bull. Geol. Soc. of Amer.*, Vol. 27, 1916, No. 2, pp. 263-294.

JOHNSON, D. W. **Date of local glaciation in the White, Adirondack, and Catskill Mountains.** Ills., bibliogr. *Bull. Geol. Soc. of Amer.*, Vol. 28, 1917, No. 3, pp. 543-552. [Questions the validity of certain arguments brought forward in support of the theory of early local glaciation (Goldthwait).]

—— [*Topographic map of the United States.*] Sheets, 1:62,500: (1) ***Belfast,*** (2) ***Cutler,*** (3) ***Machias,*** (4) ***Pasadumkeag, Me.;*** (5) ***Dover, N. H.-Me.;*** (6) ***Hornell,*** (7) ***Moira,*** (8) ***Oneonta,*** (9) ***Russell,*** (10) ***Unadilla, N. Y.*** U. S. Geol. Survey, Washington, D. C., 1917, 1918.

EUROPE

FRANCE

MUSSET, RENÉ. **Le Bas-Maine: Étude géographique.** 496 pp.; maps, diagrs., ills., bibliogr. A. Colin, Paris, 1917. 15 fr. 10 x 6½.

A complete and excellent geographical study of a region of France, to be compared with the "Picardie" of Demangeon, the "Flandre" of Blanchard, and other monographs of the French school of regional geography.

The Bas-Maine is the western part of the old province of Maine, extending over the eastern border of the Armorican massif, while the Haut-Maine extends over the Cretaceous plateaus of the southwestern part of the Paris Basin. It is particularly interesting as a typical *pays de bocage*. *Bocage* is the name for one of the geographical features of western France, wherein human occupation has effected a certain characteristic change in the landscape; it emphasizes the wooded appearance of a slightly undulating country, thoroughly cleared of forests and cultivated, with scattered farms and lines of trees enclosing every field. Other aspects are the *plaine*, not a region of plains,

but a country in which the fields are not enclosed and cattle are allowed to pasture everywhere after the harvest, the farms being ordinarily grouped in villages; the *val*, a broad alluvial flat, with various crops, cereals and hay, orchards and even vineyards; and the *lande*. The *lande* is a surface that is neither enclosed nor ordinarily cultivated and consequently is used as pasture ground: it can sometimes be cultivated for a year or two after burning the vegetation composed chiefly of heath, *Ulex*, and some grass. The Bas-Maine was formerly a country of woods, *landes*, and *bocage;* not till the last century did agriculture extend over the whole area. The study of this transformation is one of the most attractive parts of the work of Musset.

The study of the physiography leads also to some very interesting conclusions. The Bas-Maine is a region of Paleozoic, strongly folded strata, with granitic intrusions, the peneplanation of which was certainly completed in early Mesozoic times. Three platforms or peneplane surfaces can be distinguished: the "plateforme de Multone," the highest and the oldest, is only represented by flat-topped buttes and crests of hard rock; the "plateforme de la Foret de Mayenne" is more developed to the northeast, forming rolling plateaus between 200 and 330 meters in elevation, partly covered with *landes* and forests; the "plateforme de Jublains," extending over most of the region, is a typical young dissected peneplane, which can be traced even over the Cretaceous plateaus of the Haut-Maine. The author believes it was formed in the early Tertiary, because it is covered by Eocene continental deposits. It has been buried for a long time and has been recently cleared of Tertiary deposits by rejuvenated erosion. Warping in the Miocene may account for the high altitude of the platforms to the northeast and for the course of the main rivers, descending from the elevated area without any relation to the tectonic lines of the folded Paleozoic strata.

Students in human geography will be deeply interested in the second part of the book. It follows the same line as Sion's excellent work, "Les paysans de la Normandie orientale," giving pictures of the successive stages of economic life, based upon accurate historic investigations. He traces the growth of colonization and deforestation from the tenth to the thirteenth century and the development of rural life; the extension of home industry based upon the cultivation of flax and the world-wide commerce in linen cloth in the seventeenth and eighteenth centuries; the decline of this industry and the bad conditions of the country at the beginning of the nineteenth century, when more than half of the surface was nothing but pasture (*landes*); the economic revolution due to the use of chemical fertilizers (chiefly lime derived from the Paleozoic limestones) and to the improvement of roads and rivers and the building of railroads. Now the country is in excellent condition, with only 2.5 per cent of *landes;* a large stock of cattle, swine, and horses; and good crops of wheat, barley, oats, and hay.

EMMANUEL DE MARTONNE

ALLIX, A. **Vizille et le bassin inférieur de la Romanche.** Maps, diagrs., ills., bibliogr. *Recueil des Trav. de l'Inst. de Géogr. Alpine*, Vol. 5, 1917, No. 2, pp. 129-327. Grenoble. [A highly detailed and suggestive regional study of a small area in the French Alps.]

BÉNÉVENT, M. E. **La neige dans des Alpes Françaises.** Diagrs. *Recueil des Trav. de l'Inst. de Géogr. Alpine*, Vol. 5, 1917, No. 4, pp. 403-497. Grenoble. [The regimen of the snowfall is discussed in respect of quantity, frequence of precipitation, and duration of snow cover. In conclusion these factors are analyzed in their combined effect on human relation. The region naturally falls into two main subdivisions—the Northern Alps, whose precipitation is controlled by oceanic influence, and the Southern Alps, controlled by Mediterranean influence.]

BLANCHARD, RAOUL. **Bordeaux.** *Rev. de Géogr. Commerciale*, Vol. 43, 1917, No. 7-12, pp. 323-337. Bordeaux.

BLANCHARD, RAOUL. **Comparaison des profils en long des vallées de Tarentaise et Maurienne.** *Recueil des Trav. de l'Inst. de Géogr. Alpine*, Vol. 6, 1918, No. 3, pp. 261-331. Grenoble. [The valleys of the upper Isère and of its tributaries, the Doron and the Arc.]

BLANCHARD, RAOUL. **Trois grandes villes du sud-est.** Maps. *Recueil des Trav. de l'Inst. de Géogr. Alpine*, Vol. 6, 1918, No. 2, pp. 153-210. Grenoble. [This study of the towns of Lyons, Marseilles, and Nice is developed on the lines of the author's previous studies (Deux grandes villes françaises, Lille et Nancy, *La Géographie*, Vol. 30, 1914-15, pp. 103-122; Bordeaux, *Rev. de Géogr. Commerciale*, Vol. 43, 1917, pp. 323-337; Nantes et Rouen, *ibid.*, 1918). Lyons is a splendid example of geographic factors of *site* and *situation* combining to favor the development of a town (cf. *Review*, Vol. 5, p. 384). In contrast to Lyons, a town at the contact of diverse regions, is Marseilles, a town of the periphery, an entrance and an exit. Nice, like Nancy but unlike Lyons and

Marseilles, is a town of recent growth, on which political events (the annexation of 1870) have had a certain influence. Unlike Nancy, however, which has flourished especially because of its *situation*, Nice owes everything to its *site*.]

CARTER, HUNTLEY. **The new French regionalism.** *Contemporary Rev.*, No. 631, Vol. 114, 1918, July, pp. 80-86. London. [See the section on France in the note on "Proposed New Administrative Subdivisions of England, France, and Germany" in the February, 1919, *Review* (pp. 114-118).]

CHAMBARD, CLÉMENT. **La Montagne Jurassienne: Essai de géographie régionale.** With a preface by E. Fournier. xiv and 150 pp.; maps, diagrs., ills., bibliogr. Imprimerie Moderne, Lons-le-Saunier, 1914. 3 fr. 25. 10 x 6½. [A systematic study according to modern methods of the physical and human geography of the Jura Mountains within the Jura *département*.]

CLERGET, PIERRE. **La délimitation des régions économiques françaises.** *Rev. Gén. des Sci.*, Vol. 30, 1919, No. 4, p. 101. [Refers to the subdivision of France into 16 economic regions discussed in the *Review* note cited in the entry under "Carter" above. It is here stated that the Ministry of Commerce subdivision was worked out by Professor Henri Hauser of the University of Lyons "in conformity with the principles established by Paul Vidal de la Blache." The similarity of the Ministry of Commerce project and a subdivision published eight years earlier by Professor Vidal de la Blache was pointed out in the *Review* note and made apparent by there reproducing the two maps side by side. M. Clerget says that the following regions have already been officially organized: Nancy, Bordeaux, Clermont, Limoges, Rouen, Nantes, Toulouse, Montpellier. Certain cities have protested against their allocation to the region to which they were assigned in the project; thus, Nice does not wish to be included in the Marseilles region; Besançon in the Dijon region; Chambéry in the Grenoble region; Saint-Étienne in the Lyons region; Nîmes in the Montpellier region. These protests are simply an expression of marginal tendencies and will doubtless be composed satisfactorily. As the author truly remarks, a region is rooted ("*prend naissance par*") in its center and not on its periphery.]

DUNOYER, L., AND G. REBOUL. **Sur les variations diurnes du vent en altitude.** *Comptes Rendus de l'Acad. des Sci. [de Paris]*, Vol. 165, 1917, Dec. 24, pp. 1068-1071.

GORCEIX, CHARLES. **Sur une anomalie des vallées du Borne et du Nom à Saint-Jean-de-Sixt (Haute-Savoie).** Maps, diagrs. *Recueil des Trav. de l'Inst. de Géogr. Alpine*, Vol. 6, 1918, No. 3, pp. 341-369. Grenoble.

GRAVES, H. S. **Effect of the war on forests of France.** Ills. *Amer. Forestry*, No. 300, Vol. 24, 1918, December, pp. 709-717. Washington, D. C.

HARLÉ, ÉDOUARD. **Une tournée de l'ingénieur en chef Le Boullenger dans les dunes de son service entre Capbreton et Cazaux en 1817.** 32 pp.; diagr. Reprinted from *Actes de l'Acad. des Sci., Belles-Lettres et Arts de Bordeaux, 1914*. [Dunes of Gascony. Compare review of another article by the same author in *Geogr. Rev.*, Vol. 2, 1916, p. 394.]

SORRE, MAXIMILIEN. **L'avenir économique des landes.** *Ann. de Géogr.*, No. 147, Vol. 27, 1918, May 15, pp. 188-195. [Discussion of the results of a recent investigation, "Enquête sur la reprise et le développement de la vie industrielle dans la région landaise," 2nd edit., Bordeaux, 1917.]

BARRECCHIA, B. ***Carte des canaux et rivières navigables de la France et de la Belgique, avec distances kilométriques par section et partielles entre toutes les localités desservies par les voies navigables.*** 1:1,200,000. Société Éditrice Géographique, Paris, 1918. [Distinction is made between canals (1) of first and (2) second importance and (3) projected, and between navigable rivers (1) of first and (2) second importance and (3) rivers permitting of rafting. Transfer points between railroads and waterways are also indicated.]

BALKAN STATES, INCLUDING RUMANIA

SAVIĆ, V. R. **The reconstruction of South-Eastern Europe.** With a preface by Sir James George Frazer. ix and 280 pp.; map. Chapman & Hall, Ltd., London, 1917. 7s. 6d. 9 x 6.

TAYLOR, A. H. E. **The future of the Southern Slavs.** 326 pp.; map, index. Dodd, Mead & Co., New York, 1917. $3.00. 8½ x 5½.

Both authors cover ground well trodden by this time. The cause in whose behalf Savić pleads so earnestly has progressed, and the reconstruction which he recommends

around a central group formed by a union of peoples of Serbian stock is almost accomplished. Perhaps on that account, and because the viewpoint of a sound Serbian thinker deserves to be known, his book is of greater interest now than ever.

The chapter on commercial possibilities deserves special attention. Savić shows how pronounced was Serbia's isolation before the war. The free development of the country's natural resources was prevented by the Austrian policy of making the little kingdom an economic dependency of the Hapsburg's former empire. With the addition of a seacoast peopled almost exclusively by Serbians, Serbia will acquire trade relations with the world, and the incentive to develop the country's natural resources will be correspondingly increased. Had these features been treated more extensively in the space devoted to the necessarily incomplete war history, the usefulness of the book would have been greater.

Of pertinent interest are the author's words on reconstruction. His plans for the building of railways and canals are not merely of Serbian or Balkan concern but bear on economic problems which belong to European trade and traffic. By its resources as well as by position—both geographical factors—Serbia has a definite line of development marked out by nature which is revealed in its national aims. The failure of Teutonic endeavor in the country is excellent proof that policies tending to oppose natural forces which shape national development are doomed to failure.

Under the title "The Problem of the Adriatic," Savić presents a chapter of Serbian claims to the coast of this sea. Here, in common with many writers, the author appears to ignore the fact that the Adriatic presents considerable analogy with problems of national jurisdiction over river waters forming the boundary between adjoining states. The analogy appears even greater when it is remembered that the Adriatic is an outlet not only for Serbs and Italians but also for Hungarians, Austrians, and Albanians and that Greek interests are also affected.

A much broader treatment of the Adriatic problem will be found in Taylor's work. This author shows that the solution is one which not only affects Italy and Serbia but has deep bearing on European politics. Its settlement in a manner which will satisfy both Serbians and Italians is of prime necessity for the peace of Europe.

An excellent perspective on the Serb's proper place in Europe is provided by Taylor. Not by overturning the past but by maintaining its tradition Serbia will continue to be a main link in the intercourse between Europe and Asia. This continuity of historical function is the unavoidable outcome of geography. LEON DOMINIAN

ALMAGIÀ, ROBERTO. **Il territorio d'occupazione italiana in Albania e l'opera dell'Italia.** *Riv. Coloniale*, Vol. 13, 1918, No. 5, pp. 185-195. Rome.

ANNONI, A. M. **La Jugoslavia economica.** *L'Esplorazione Commerc.*, Vol. 33, 1918, No. 5-6, pp. 81-90; No. 7-8, pp. 105-115; No. 9-11, pp. 146-162. Milan.

AZZI, GEROLAMO. **Quadro fenologico della Bulgaria.** Maps. *Boll. Reale Soc. Geogr. Italiana*, Vol. 7, 1918, No. 5-6, pp. 417-433. Rome.

CVJIĆ, J[OVAN]. **L'époque glaciaire dans la péninsule Balkanique.** Maps, diagrs. *Ann. de Géogr.*, No. 141, Vol. 26, 1917, pp. 189-218; No. 142, pp. 273-290.

CVJIĆ, JOVAN. **Unité ethnique et nationale des Yougoslaves.** *Scientia*, No. 74, Vol. 23, 1918, pp. 455-463. Bologna. [Cf. article by the author, "The Geographical Distribution of the Balkan Peoples," *Geogr. Rev.*, Vol. 5, 1918, pp. 345-361.]

DE CRISTO, GIUSEPPE. **Nelle Macedonia greca: Note di geografia etnografica.** *La Geografia*, Vol. 6, 1918, No. 2, pp. 89-94. Novara.

DVORSKY, V. **Alcuni tipi di sedi umane presso gli Slavi meridionali.** *Atti X Congr. Internaz. di Geogr., Roma, 1913*, pp. 1090-1093. Reale Società Geografica, Rome, 1915.

EVANS, ARTHUR. **The Adriatic Slavs and the overland route to Constantinople.** Map. *Geogr. Journ.*, Vol. 47, 1916, No. 4, pp. 241-265 (discussion, pp. 261-265). [See *Geogr. Rev.*, Vol. 2, 1916, pp. 307-308 and 467-468.]

GALLOIS, L. **Les populations slaves de la Péninsule des Balkans.** Map. *Ann. de Géogr.*, No. 150, Vol. 27, 1918, pp. 434-460.

GIUFFRIDA-RUGGERI, V. **I Valacchi dell' Adriatico.** 13 pp. Extract from *Riv. Italiana di Sociologia*, Vol. 20, 1916, No. 5-6. Rome. [The Vlakhs of Dalmatia, Albania, etc.]

MUSONI, FRANCESCO. **Problemi etnografici e politici della penisola balcanica.** *Riv. Geogr. Italiana*, Vol. 25, 1918, No. 1-2, pp. 1-23. Florence. [A good review of Balkan problems but presenting nothing new.]

NEWBIGIN, M. I. **Constantinople and the Straits: The past and the future.** *Scottish Geogr. Mag.*, Vol. 33, 1917, No. 11, pp. 507-515. [Review of "The Question of the Bosphorus and Dardanelles," by Coleman Phillipson and Noel Buxton, London, 1917, and "The Site of Constantinople: A Factor of Historical Value," by Leon Dominian, *Journ. Amer. Oriental Soc.*, Vol. 27, 1917.]

SCRIVEN, G. P. **Recent observations in Albania.** Map, ills. *Natl. Geogr. Mag.*, Vol. 34, 1918, No. 2, pp. 90-114.

TSANOFF, R. A. **Bulgaria's case.** *Journ. of Race Devel.*, Vol. 8, 1918, No. 3, pp. 296-317. Worcester, Mass.

WOODS, H. C. **Communications in the Balkans.** Map, ills. *Geogr. Journ.*, Vol. 47, 1916, No. 4, pp. 265-293 (discussion, pp. 290-293).

—— ***Balkan Peninsula, The theatre of war in the.*** 1:1,140,000, or 1 in. to 18 miles. (Stanford's War Maps, No. 16.) Edward Stanford, Ltd., London, March, 1916. [Elevations in five grades of altitude tints in brown.]

—— ***Macédoine-Albanie.*** 1:600,000. A. Taride, Paris, 1917. [Relatively large scale. No relief.]

AFRICA

GENERAL

CHUDEAU, R. **Le climat de l'Afrique occidentale et équatoriale.** Maps, diagrs. *Ann. de Géogr.*, No. 138, Vol. 25, 1916, pp. 429-462.

Tropical west Africa is a region of great climatic diversity. Between 5°S. and 28°N. there were few meteorological stations before 1900; now there are more than 100 records covering several years, and a detailed discussion of the climates is possible. There are three types of climate here: (1) Saharan, always dry, temperature ranges very great; (2) equatorial, always humid, small variation of the climatic elements; (3) intermediate, or Nigerian, dry-season Saharan, wet-season equatorial. The secondary types, littoral, forest, and mountain are moister, cooler, and less extreme than those of the open interior plains.

In the Sahara, at In-Salah (28°N.), the coldest weather comes at about the same time as the least sunlight, January or December; the warmest month is July. The absolute range in eleven years was from —3.4° C. to 52°; the mean daily range, 18°. The atmospheric pressure here as elsewhere throughout the region follows in reverse order the temperature changes: high in winter and low in summer. The winds of the Sahara are the northeast trades by day; there is calm by night. The air at times is so dry that no trace of moisture can be found with psychrometric readings. The average (42 months) vapor pressure, 7.2 millimeters at In-Salah, is practically the same as the annual of New York City. The potential annual fresh-water evaporation in the Sahara is said to be 3.7 meters. The total rainfall collected at In-Salah in eleven years was the 8.1 millimeters which fell in January and March, 1910.

The equatorial climate at Brazzaville (4°S.) is characterized by a moderate daily temperature range of 11°; and temperatures from September to May by a range of 25° or 26°, April of almost 27°, and July of 21°. The absolute extremes in five years were 12.3° and 38.3°. Rain occurs in all months in this region, with a double maximum. Along the north coast of the Gulf of Guinea the annual rainfall generally exceeds 2,000 millimeters. Debundja at the head of the gulf, at five meters altitude on the west foot of Kamerun Peak, has an eleven-year average of 10,469 millimeters, which is exceeded only by that of Cherrapunji, India, with 11,626 millimeters (Hann). The Guinea forest has a temperature of 26° as compared with 27.5° in the open country to the north. The forests, especially in July, are marked by high pressures. That over the Guinea forest has a strong effect on the general southwest monsoon.

In the intermediate, or Nigerian, region at Niamey (13½°N.), the highest temperatures come in April just before the rainy season, but the highest mean and minimum temperatures occur in May. The daily range is 10° in the wet season and 18° or more in the dry. A diagram shows strikingly the blanketing effect of cloudiness on the temperature range. The equatorial double temperature maxima are found north almost to the Sahara. The littoral climates are locally cool and dry, like the Peruvian, especially between 14° and 21°N., where the ocean water is 16.5° C. to 21.3° C. Some distance off shore the temperature is 27° C. to 28° C. The winds of the dry season are the trades from the Sahara which extend south to about 5°; in the wet season the southwest monsoon prevails as far as Lake Chad (14°N.), but on the west coast the trades come south to 10°N. The floods of the Niger from July to February give the southwest wind the

character of a sea breeze on the leeward bank, near Timbuktu. The rainfall increases to 500 millimeters at about 350 kilometers south of the Sahara. Beyond this there are two maxima, irrigation is not necessary, and the vegetation is more varied. A phenomenon of the rainy season is the original "tornado," apparently a heat thunderstorm, with squall, pressure rise, and heavy rain, which comes from the southwest. Some tornadoes travel 75 kilometers an hour. Excellent maps and diagrams illustrate the contribution. CHARLES F. BROOKS

PATTON, C. H. **The lure of Africa.** xiv and 205 pp.; maps, ills., bibliogr., index. Missionary Education Movement of the United States and Canada, New York, 1917. 8 x 5.

Half of the book is given to the remarkable advance of Mohammedanism in Africa. Islam has been firmly established in the Mediterranean countries for about twelve centuries. From these northern states the Mohammedan propaganda has spread over the Sahara, conquered a large part of the Sudan, and is now advancing southward with remarkable impetus. The author describes the Protestant missionary enterprises now in the field or organizing to stem, if possible, this southern march of Islam.

The author and many other writers make a mistake which, strangely enough, has been promoted in every way by the best writers on South Africa. He speaks of the blacks of that region as Kafirs or Kafir tribes and refers to the Kafir war of the Zulus. Long ago Mohammedan propagandists went down the east coast and preached Islam among the blacks of South Africa. They utterly failed to win the natives to the faith of Mohammed and went away disgusted; and the only name they had for the tribes that repelled them was Kafir, an Arabic word meaning "infidel." The whites ignorantly adopted this word as a general term applicable to most of the South African blacks; and missionaries have had their full share in fastening it upon the Bantu tribes of that region.

The author mentions many of the remarkable facts in the present stage of African reclamation. Great Britain, for example, maintains her rule in the colony of Gambia by means of only 75 native police and soldiers. In Nyasaland she has a military force of only 35 native soldiers. In Uganda the Christian population numbers 374,264, according to the latest statistics. The Arab slave dealer has gone out of business, and scores of thousands of black men are engaged in remunerative labor for the whites. Mr. Patton mentions the fact that one Katanga mine employs 5,000 natives, another 2,000; he might have added that 35,000 blacks are working for the whites in the Katanga district. At Dr. Lapsley's missions on the Kasai River nearly 16,000 children are attending the Sunday Schools. As the author says, Africa is now the great field for industrial education, and in every large mission the teaching of agriculture and trades occupies a basal place in the educational system. CYRUS C. ADAMS

SAHARA, INCLUDING EGYPT

BELL, ARCHIE. **The spell of Egypt.** xiii and 36 pp.; map, ills., bibliogr., index. The Page Co., Boston, 1916. 8 x 6. [One of the better class of books on the Nile tour.]

BRIZIO, F. A. **Un viaggio in Tripolitania.** 232 pp.; ills. Società Editoriale Milanese, Milan, 1912. L. 3.50. 9 x 6½.

C[ANA], F. R. **The north-west frontier of Egypt.** Map. *Geogr. Journ.*, Vol. 47, 1916, No. 2, pp. 130-134.

CECCHERINI, UGO, edit. **Bibliografia della Libia (in continuazione alla "Bibliografia della Libia" di F. Minutilli).** ix and 204 pp.; index. Minist. delle Colonie, Rome, 1915. 9½ x 6½.

—— **Egypt, In the western desert of.** *Blackwood's Edinburgh Mag.*, No. 1216, Vol. 201, 1917, pp. 206-222. [Account of the military campaign in Egypt in January, 1916, with details of the attack on the Siwa Oasis.]

EREDIA, F[ILIPPO]. **Contributo alla climatologia del Gebel.** 20 pp.; diagr. Reprint from *L'Agricoltura Coloniale*, Vol. 11, 1917. Istituto Agricolo Coloniale Italiano, Florence.

EREDIA, FILIPPO. **Correlazione tra la temperatura dell'Italia e dell'Egitto.** Reprinted from [*Atti*] *Reale Accademia dei Lincei*, Vol. 26, 1917, No. 11, pp. 607-609. Rome.

EREDIA, FILIPPO. **La neve in Tripolitania.** Ills. *Minist. delle Colonie Boll. di Informazioni*, Vol. 4, 1916, No. 10-11-12, pp. 539-547. Rome. [Notes on snowfall frequency with photographs of snow scenes in Tripoli taken during the unusually snowy years of 1913 and 1915.]

EREDIA, FILIPPO. **Sul clima di Ghadàmes.** 25 pp.; diagr. Reprinted from *Minist. delle Colonie Boll. di Informazioni*, Vol. 4, No. 4-5-6, 1916. Rome. [Ghadàmes is the westernmost oasis of Tripolitania, some 300 miles inland from the Greater Syrtis.]

EREDIA, FILIPPO. **Sul temporale verificatosi a Tripoli nell'ottobre 1915 e sulla distribuzione dei temporali in Tripolitania.** Maps. Reprinted from *Minist. delle Colonie Boll. di Informazioni*, Vol. 3, 1915, No. 12, pp. 1-17. Rome. [On storms in Tripoli.]

HORNEMANN, FEDERIGO. **Diario del viaggio dal Cairo a Murzuch negli anni 1797 e 1798.** (Riproduzione di scritti dispersi o rari.) *Archiv. Bibliogr. Coloniale (Libia)*, Vol. 2, 1916, No. 1, pp. 43-68; No. 2, pp. 109-138. Florence. [A translation from the original German publication of Hornemann's diary of his journey made toward the end of the eighteenth century—the first in modern times across the northeastern Sahara.]

SMYTH, W. H. (1) **La costa settentrionale dell'Africa.** (2) **Una via aperta verso l'Africa centrale.** (Riproduzione di scritti dispersi o rari.) *Archiv. Bibliogr. Coloniale (Libia)*, Vol. 1, 1915, No. 2-3-4, pp. 157-198. Florence. [The original was contained in an appendix to Admiral Smyth's book on the Mediterranean, published in London, 1854.]

STROMER, ERNST. **Geographische Beobachtungen in den Wüsten Ägyptens.** 26 pp.; ills., bibliogr. Reprint from *Mitt. des Ferdinand von Richthofen-Tages, 1913.* Dietrich Reimer (Ernst Vohsen), Berlin, 1914.

TROTTER, ALESSANDRO. **Flora economica della Libia: Statistica illustrata delle piante coltivate e delle spontane utili della règione. Seguita da una appendice intorno alle droghe del commercio locale.** 375 pp.; map, diagrs., ills., indexes. (Series: Manuali Coloniali). Minist. delle Colonie, Rome, 1915. 8 x 6.

—— ***Baharia Oasis, Cultivated lands of.*** [In 2 sheets, being a set of 9 maps, as follows, each 1:10,000:] (1) ***The Four Principal Villages: El Qasr, Bawitti, Mandisha, Zabu, and their environs;*** (2) ***Ain el Begum and environs;*** (3) ***Ain Baharia;*** (4) ***Ain Merun and environs;*** (5) ***Gafâra;*** (6) ***El Ris;*** (7) ***Tab el limun;*** (8) ***El Hez and El Gharbia;*** (9) ***El Harra and environs.*** Index, key to positions of inset maps, 1:500,000. Survey of Egypt, [Giza,] January, 1918. [Gives an admirable picture on a large scale of oasis cultivation. There are separate symbols for (1) palm groves, (2) wheat, maize, and barley fields, and (3) rice fields. The soil conditions are differentiated as (1) swamps and marsh lands; (2) salt-encrusted ground; (3) salty ground with scrub; (4) drifted sand; and (5) sandy ground with scrub. Status as in the winter of 1917-18.]

BALL, JOHN. ***Geological map of west-central Sinai.*** 1:50,000. Accompanying as Plate I, "The Geography and Geology of West-Central Sinai," by John Ball, Cairo, 1916. Survey Department, Cairo, 1916. [See the note on "The Geography of the West-Central Sinai Peninsula" in the *Review* for November, 1918, p. 452.]

—— [***Topographical map of Egypt.***] 1:10,000. Sheets: ***N. E. 13-26, 14-24, 15-25, 15-27, 21-12, 21-16, 21-18, 21-20, 22-18, 22-20, 23-14, 23-15; N. W. 23-20, 24-20.*** Surveyed in 1901-11; revised in 1913-14. Survey Department, Egypt.

ASIA

SIBERIA

BLANC, ÉDOUARD. **La colonisation et la mise en valeur de la Sibérie et de la steppe asiatique.** *Ann. de Géogr.*, No. 134, Vol. 25, 1916, pp. 124-142.

BLANC, ÉDOUARD. **Le nouveau réseau des chemins de fer de l'Asie russe.** *Ann. de Géogr.*, No. 136, Vol. 25, 1916, pp. 263-290.

DEMIANOF, V. P. **Siberia—a country of the future.** Ills. *The Americas*, Vol. 5, 1918, No. 1, pp. 8-15. New York.

GORODKOV, B. **Rapport préliminaire sur une excursion dans la contrée de Liapine du gouvernement Tobolsk en 1915.** *Bull. Acad. Imp. des Sci.* [*de Pétrograd*], Ser. 6, 1916, No. 2, pp. 91-94. [In Russian.]

SCHOKALSKY, JULES DE. **La comparaison des mesures de superficie de l'Asie Russe et de ses bassins.** *Atti X Congr. Internaz. di Geogr., Roma, 1913*, pp. 642-651. Reale Società Geografica, Rome, 1915.

SHKLOVSKY, I. W. ("DIONEO"). **In far north-east Siberia.** Translated by L. Edwards and Z. Shklovsky. 264 pp.; maps, ills., index. Macmillan & Co., Ltd., London,

1916. $3.00. 9 x 6. [Though the four-year sojourn among the Yakuts along the Kolyma River, which is the subject of this book, was made over twenty-five years ago, this translation from the Russian is well worth while.]

INDIA

BENTON, JOHN. **The Punjab triple canal system.** Edit. by J. H. T. Tudsbery. 52 pp.; maps, diagrs. *Minutes of Proc. of Inst. of Civil Engineers*, Vol. 201, Session 1915-16, Part I. London, 1916. [Abstracted in *Engineering* (London), No. 2603, Vol. 100, 1915, Nov. 19, p. 515, and in the *Geogr. Rev.*, Vol. 5, 1918, pp. 149-150.]

DICKINSON, ALFRED. **Water power in India.** *Journ. Royal Soc. of Arts*, No. 3417, Vol. 66, 1918, pp. 417-426 (discussion, pp. 422-426). London.

DOUIE, JAMES. **The Panjab, North-West Frontier Province, and Kashmir.** xiv and 373 pp.; maps, diagrs., ills., index. (Provincial Geographies of India, T. H. Holland, general edit.) University Press, Cambridge, 1916. $1.80. 8 x 5½. [The book is very rich in content. It deals with a region that includes some of the highest parts of the earth's surface; with rich lowlands, nine-tenths of whose people live in the 44,000 villages of the Punjab, which have a density of population comparable with that of the British Isles; with large parts of desert areas that have been wholly reclaimed by irrigation; and with six climatic zones in an area a little less than that of Texas.]

DUNBAR, G. D. **Tribes of the Brahmaputra valley.** *Journ. Royal Soc. of Arts*, No. 3249, Vol. 58, 1915, pp. 290-299. London.

—— [***Topographic map of India.***] 1:253,440. Sheets: ***56 O, Madras and Hyderabad; 56 N, Hyderabad and Central Provinces.*** Survey of India, Calcutta, 1914, 1915. [Two maps particularly interesting because portraying the extensive development of artificial reservoirs or "tanks," such as are used more sparingly in arid parts of the southwestern United States. The tanks of Hyderabad were constructed in enormous

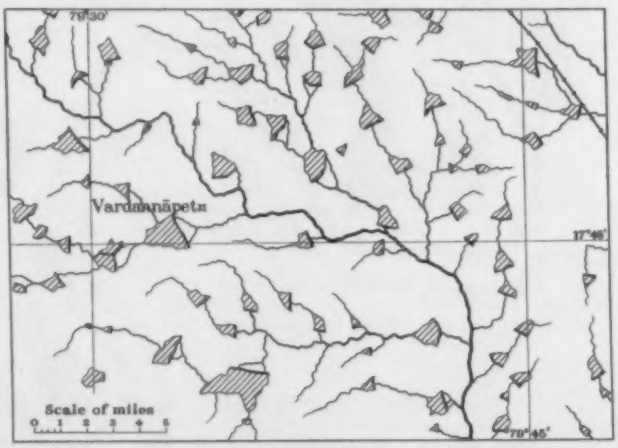

FIG. 1—Map showing a small area in Hyderabad, in which artificial reservoirs abound. Scale, 1:400,000. (Reduced section from the topographic map of India, 1:253,440, Sheet 56 O.)

number in the hollows of an undulating hilly country by the Hindu dynasties, and represent one of the most elaborate systems of tank irrigation in the world. A brief description of the tanks will be found in the *Review*, Vol. 1, 1916, p. 302. The map emphasizes a fact of great geographical interest—the high proportion of the people of India that live in villages and on small holdings of land. India has, in proportion to its total population, an astonishingly small number of large cities. (See the "Census of India for 1911," reviewed above, and "British India with Notes on Ceylon, Afghanistan and Tibet," *Special Consular Rept. No. 72*, U. S. Dept. of Commerce, Washington, D. C., 1915.)—D. W. JOHNSON.]

—— [*Topographic map of India.*] 1:253,440. Sheets: ***78 G, Bengal and Assam; 78 H, Bengal; 78 J, Assam and Bhutan.*** Survey of India, Calcutta, 1913, 1914. [Three maps showing a large, mature, overloaded stream (the Brahmaputra River) whose braided character is remarkably pronounced. The type of braiding is similar to that

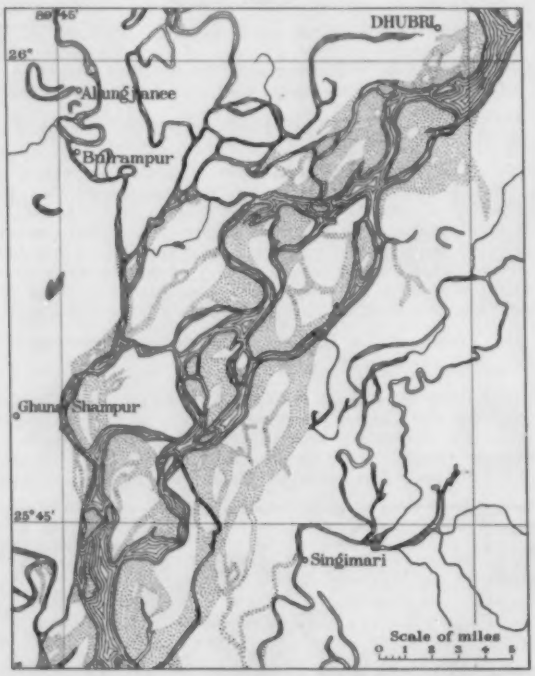

FIG. 2—Map of a portion of the Brahmaputra River at its exit from the Assam trough, showing the braided character of the stream. Scale, 1:400,000. (Reduced section from the topographic map of India, 1:253,440, Sheet 78 G.)

shown along the Missouri and Mississippi Rivers on the O'Fallon topographic quadrangle in Missouri and Illinois, but is more extensively developed. In quality of execution the maps are scarcely creditable to the India Survey.—D. W. JOHNSON.]

HUMAN GEOGRAPHY

GENERAL

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